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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: **Lu et al.** Serial No.: 09/909,224 For: AUDIENCE MEASUREMENT SYSTEM FOR DIGITAL TELEVISION Filed: July 19, 2001 Group Art Unit: 2424 Examiner: Justin E. Shepard	I hereby certify that this document is being deposited electronically with the United States Patent and Trademark Office on this date: **October 18, 2010** **/Lauren A. Mercado/** Lauren A. Mercado

BRIEF ON APPEAL

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P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Pursuant to the Notice of Appeal filed on March 16, 2010 in connection with the above-identified patent application, Applicants respectfully submit the instant Brief on Appeal in accordance with 37 C.F.R. § 41.37. This Brief is being submitted with a petition and fee for an extension of time pursuant to 37 C.F.R. § 1.136.

I. Real Party In Interest

The Nielsen Company (US), LLC is the real party in interest to this appeal. The above-referenced patent application has been assigned to The Nielsen Company (US), LLC, by Nielsen Media Research. The assignment has been recorded in the United States Patent and Trademark Office ("PTO") at Frame 0259 of Reel 023030. The above-referenced patent application was previously assigned to Nielsen Media Research by the inventors, Daozheng

Lu, Paul Kempter, and William Feininger. The assignment to Nielsen Media Media Research has been recorded in the United States PTO at Frame 0302 of Reel 021622.

II. Related Appeals and Interferences

The Applicants are unaware of any related appeals or interferences.

III. Status of the Claims

Currently, claims 13-21, 28-39, 61-69, 79-90, 92-94, 99-100, and 102 are pending in this application. Claims 1-12, 22-27, 40-60, 70-78, 91, 95-98, 101, and 103 are canceled. The pending claims are presented in the Claims Appendix of this Brief. Claims 13-21, 28-39, 61-69, 79-90, 92-94, 99-100, and 102 stand rejected under 35 U.S.C. § 103. Therefore, claims 13-21, 28-39, 61-69, 79-90, 92-94, 99-100, and 102 form the subject matter of this appeal.

IV. Status of the Amendments

The amendments that were made in this application have been entered. No amendments were filed after the final Office action.

V. Summary of the Claimed Subject Matter

Although reference numerals and specification citations are inserted below in accordance with C.F.R. 41.37(c)(1)(v), these references numerals and citations are merely examples of where support may be found in the specification for the terms used in this section of the brief. There is no intention to in any way suggest that the terms of the claims

are limited to the examples in the specification. Although, as demonstrated by the reference numerals and citations below, the claims are fully supported by the specification as required by law, it is improper under the law to read limitations from the specification into the claims. Pointing out specification support for the claim terminology as is done here to comply with rule 41.37(c)(1)(v) does not in any way limit the scope of the claims to those examples from which they find support. Nor does this exercise provide a mechanism for circumventing the law precluding reading limitations into the claims from the specification. In short, the reference numerals and specification citations are not to be construed as claim limitations or in any way used to limit the scope of the claims.

Independent claim 13 is directed to a system. The television audience measurement system (60, 100, 200, 300, 400) for digital television (66, 110, 224, 324, 410) is disposed in a statistically selected location (62, 102, 202, 302, 402). (See, e.g., FIGS. 2-6 and paragraphs [0035], [0044], [0054], [0057], [0063], [0066], [0073], and [0074]). The system includes a software agent (112, 118, 122, 500) and a communication apparatus (114, 116, 120, 124, 170). (See, e.g., FIGS. 3 and 7 and paragraphs [0046]-[0048], [0050]-[0051], [0079]-[0090]). The software agent is adapted to read a program identification (PID) header from a data packet containing a portion of a tuned digital television program to identify the television program tuned by the digital television equipment. (See, e.g., Abstract, FIGS. 2, 4, 5, and 7, and paragraphs [0015], [0035]-[0038], [0040]-[0041], [0053], [0056], [0061], [0064], [0079], and [0081]). The software agent is stored in memory associated with the digital television equipment, and the PID header is broadcast with the data packet to enable the digital equipment to tune to a selected one of a plurality of minor channels broadcast in a major channel. (See, e.g., FIG. 3 and paragraphs [0007], [0015], [0045]). The software agent stores

at least a portion of the PID header in association with a timestamp. (See, e.g., FIG. 3 and paragraphs [0003], [0019], [0046]-[0048]). The communication apparatus is adapted to transmit at least one of the at least the portion of the PID header and media identification information obtained via the PID header to a remotely located central office. (See, e.g., FIG. 3, 4, and 6, and paragraphs [0015], [0050], [0061], [0071], [0078]).

Independent claim 61 is directed to a tangible computer-readable storage medium including a set of instructions. The set of instructions, when executed, provide a software agent (112, 118, 122, 500) stored in memory associated with digital television equipment. (See, e.g., FIG. 3 and paragraphs [0015] and [0045]). The software agent is arranged to acquire television audience measurement data relative to the digital television equipment. (See, e.g., FIGS. 3 and 7 and paragraphs [0007], [0015], [0019], [0045]-[0048], and [0079]-[0087]). The software agent includes first instructions to store and timestamp at least a portion of a television program identification (PID) header from a data packet containing a portion of a tuned television program to identify the television program selected for viewing on the digital television equipment. (See, e.g., FIG. 3 and paragraphs [0003], [0019], and [0046]-[0048]). The software agent includes second instructions to log a co-transmitted datum transmitted in a same major channel as the television program selected for viewing on the digital television equipment, the co-transmitted datum being related to the tuned television program. (See, e.g., FIG. 7 and paragraphs [0019]-[0020] and [0083]-[0084]). The software agent includes third instructions to log an Internet identification datum associated with an Internet task of the digital television equipment. (See, e.g., FIGS. 3 and 7 and paragraphs [0010], [0020], [0051], [0084]-[0085], and [0092]).

Independent claim 62 is directed to an apparatus. The apparatus is provided for identifying a viewer selected television program from among a plurality of time overlapped television programs broadcast in a viewer selected broadcast channel and received by digital television program reception equipment. (See, e.g., FIGS. 3 and 7 paragraphs [0007], [0015], [0019], [0045]-[0048], and [0079]-[0087]). The digital television program reception equipment has a data port to export tuned data. (See, e.g., FIGS. 3, 4, and 6, and paragraphs [0027], [0046]-[0048], [0050], [0072], and [0075]-[0077]). The apparatus includes a reader connected to the data port to read program identifying data tuned by the digital television program reception equipment from among data exported from the digital television program reception equipment via the data port for use by a media device different from the digital television program reception equipment. (See, e.g., FIGS. 3 and 6, paragraphs [0045]-[0048], [0050], [0072], [0074]-[0078]). The data port operates in accordance with the IEEE 1394 protocol and the program identifying data read by the reader are identifier tags exported with the data in accordance with the IEEE 1394 protocol. (See, e.g., FIGS. 3 and 6, paragraphs [0050] and [0078]). The apparatus also includes a memory to store the program identifying data. (See, e.g., FIGS. 3 and 7, and paragraphs [0003], [0045], and [0082]).

Independent claim 79 is directed to a method. The method is implemented by a software agent stored in memory associated with digital television equipment. (See, e.g., FIG. 3 and paragraphs [0015] and [0045]). The software agent is arranged to acquire television audience measurement data relative to the digital television equipment. (See, e.g., Abstract, FIGS. 2-5 and 7, and paragraphs [0015], [0035]-[0038], [0040]-[0041], [0053], [0056], [0061], [0064], [0079], and [0081]). The method includes storing and time stamping at least a portion of a television program identification (PID) header from a data packet

containing a portion of a tuned television program to identify the television program selected for viewing on the digital television equipment. (See, e.g., FIG. 3 and paragraphs [0003], [0007], [0015], [0019], [0045]-[0048]). The method includes logging a co-transmitted datum transmitted in a same major channel as the television program selected for viewing on the digital television equipment, the co-transmitted datum being related to the tuned television program. (See, e.g., FIG. 7 and paragraphs [0019]-[0020] and [0083]-[0084]). The method includes logging an Internet identification datum associated with an Internet task of the digital television equipment. (See, e.g., FIGS. 3 and 7, and paragraphs [0010], [0020], [0051], [0084]-[0085], and [0092]).

Independent claim 80 is directed to a method. The method is provided for identifying a viewer selected television program from among a plurality of time overlapped television programs broadcast in a viewer selected broadcast channel and received by digital television program reception equipment, wherein the digital television program reception equipment has a data port to export tuned data to a second media device. (See, e.g., FIGS. 3 and 5-7, and paragraphs [0007], [0015], [0019], [0027], [0045]-[0048], [0050], [0072], and [0075]-[0087]). The method includes intercepting program identifying data tuned by the digital television program reception equipment from among data exported from the digital television program reception equipment via the data port. (See, e.g., FIGS. 3 and 5-6, and paragraphs [0045]-[0048], [0050], [0072], [0074]-[0078]). The data port operates in accordance with the IEEE 1394 protocol, and the program identifying data includes identifier tags exported with the data in accordance with the IEEE 1394 protocol. (See, e.g., FIGS. 3 and 6, and paragraphs [0050] and [0078]). The program identifying data is exported to the second

media device and stored. (See, e.g., FIGS. 3 and 7, and paragraphs [0003], [0045], and [0082]).

VI. Grounds of Rejection To Be Reviewed on Appeal

The grounds of rejection to be reviewed on appeal are as follows:

Ground 1. Whether claims 13-21, 28-39, 61, 79, 88-90, 92-93, and 99 are unpatentable over Houston (U.S. Patent 6,353,929) in view of Ozkan (U.S. Patent 6,031,577).

Ground 2: Whether claims 62-69, 80-87, 94 and 102 are unpatentable over Houston in view of Welsh (U.S. Patent 5,374,951) and Saito (U.S. Patent 6,751,221)..

VII. Argument

Ground 1. Claims 13-21, 28-39, 61, 79, 88-90, 92-93, and 99 are patentable over the Houston/Ozkan combination

A. The Art Does Not Teach Timestamping PIDs As Recited In Claim 13

Claim 13 is directed to a new type of audience measurement system for monitoring digital television broadcasts. Importantly, the audience measurement system of claim 13 includes a software meter to collect and timestamp PID (**P**acket **ID**entification) headers. PID headers are expressly defined in claim 13 to be "broadcast with the data packet to enable the digital equipment to tune to a selected one of a plurality of minor channels broadcast in a major channel." The art as of the priority date of this application (May 12, 1998) did not teach or suggest timestamping PID headers. On the contrary, PID headers were used or contemplated for use by tuning equipment for tuning a user selected channel from a digital television broadcast. None of the art relied upon by the Examiner has any indication whatsoever that PID headers have any use for audience measurement or that there would be any need at all for timestamping PID headers as contemplated by claim 13. Instead, all of the audience measurement art relied upon by the Examiner either ignores the presence of PID

headers or merely references the use of PID headers for their conventional tuning purposes. As such, absent hindsight reference to the applicants' disclosure, no person of ordinary skill in the art would have arrived at the combination of claim 13 as of the May 12, 1998 priority date based on the art relied upon by the Examiner.

More specifically, claim 13 is patentable over the Houston/Ozkan combination employed by the Office action. To understand why, it is important to first understand the basics of digital television transmission. Digital television transmission systems were known prior to the invention of the instant application. Such systems involve the packetization and broadcast of content over channels located at certain agreed frequencies. Each of these frequencies defines a single major channel. Each major channel has sufficient bandwidth to simultaneously carry multiple programs, if desired, or to carry a single high resolution program. These programs carried within a major channel are referred to as minor channels or sub-channels. The programs to be broadcast as minor channels are converted to digital packets, multiplexed, and then broadcast as a stream of packets at the frequency defined by their corresponding major channel. Each program is typically associated with a stream of audio packets and a stream of video packets as well as other control or data streams. Thus, a tuner that has been instructed to tune to minor channel 1 associated with program 1 carried on major channel 200 is faced with the problem of determining which of the packets it is receiving on major channel 200 are to be presented to the viewer.

In order to enable the tuner to distinguish between the various packets in the multiplexed steam (and, thus, to tune the appropriate minor channel), every broadcast packet is labeled with an identifier known as a **P**acket **ID**entification (PID) header. The PID header will, thus, for example, identify its packet as associated with one of the minor channels

carried in the tuned major channel. As a result, the tuner can quickly tune to the appropriate minor channel requested by the viewer by displaying only those video packets and playing only those audio packets labeled with the PID headers indicating they are associated with the minor channel to be tuned, and discarding all packets labeled as associated with other minor channels by comparing the PID headers of the streaming packets to a PID provided by the user via channel selection.

Importantly, PID headers are re-used for different programs at different times. Thus, as a simple example, PID #2 could be used to broadcast "Friends" at 6PM on Thursday on major channel 200 and PID #2 could again be used broadcast the local news at 6:30PM on that same day on the same major channel 200. Thus, PIDs are intended to enable a tuner to distinguish between multiplexed program streams received <u>at a given moment in time</u>, but are not intended to distinguish between programs from time to time or across major channels. Another way to put this is PID headers are for tuning and, thus, to distinguish streams of packets multiplexed in the same major channel, but are not intended to identify program content in a universal sense. Thus, in the above example, the same program "Friends," might be broadcast on another day on the same channel at the same time, but using an entirely different PID (e.g., PID #3).

Against this backdrop, one can immediately see that, absent hindsight reference to applicant's disclosure, it is far from clear that PIDs would be of use for an audience measurement entity seeking to determine which of the many available programs on the many available major and minor channels are tuned. Indeed, the USPTO ***has previously recognized this very point***. To better understand this, it is necessary to consider some history. In particular, claim 13 of this application was originally rejected based on Aras, US

Patent 5,872,588 (Office action of October 19, 2005). This was a very surprising turn of events because it ***flatly contradicted a prior ruling by a Reexamination Examiner*** of the USPTO that, Aras provided no motivation to store PID information in association with timestamps. In particular, the parent of this application, namely, US patent application serial number 09/076,517 (the “parent application”) includes claims which were copied in an effort to provoke an interference with Massetti, U.S. Patent 5,974,299 (the “’299 Patent”).

The very same examiner who examined and allowed the Massetti ‘299 Patent, rejected the claims copied from the Massetti '299 Patent in the parent application as unpatentable over Aras et al. This was another surprising turn of events because the parent application has an earlier filing date than the ‘299 Patent and the Aras et al. reference was considered by that same examiner during the proceedings which led to the issuance of the ‘299 Patent. Since the examiner found the copied Massetti claims patentable over Aras et al. in the context of the ‘299 Patent, logical consistency demanded that those same claims would be patentable over Aras et al. in applicants’ earlier filed application; unless, of course, the USPTO acted in error in allowing the ‘299 Patent.

In view of the USPTO’s inconsistency, the applicants for the parent application responded by traversing the rejections. In response, the Examiner sustained his rejections based on Aras et al. and implicitly invited the applicants to file a request for reexamination of the '299 Patent. Therefore, the applicants filed a request for reexamination of the Massetti ‘299 Patent based on the Aras patent and other references.

In the reexamination of the ‘299 Patent (Control No. 90/007,057), the USPTO ultimately issued a notice of allowance stating:

> ***Aras fails to teach or suggest recording the PID … along with the time [of] reception, in that Aras teaches recording the payload data of the PID, and which has more information than the PID alone.*** Consequently, there is no motivation to store the PID information of Aras in that the Aras system already has similar information (derived from the payload portion but not the PID per se).

(Control No. 90/007,057, Notice of Intent to Issue Ex Parte Reexamination Certificate dated April 3, 2006, Statement of Reasons for Patentability and/or Confirmation, Pages 12-13)(emphasis added). Therefore, the USPTO has previously concluded that Aras does not teach or suggest a software agent adapted to read and timestamp a program identification (PID) header to identify a television program tuned by digital television equipment as recited in claim 13. On the contrary, as noted by the USPTO in its earlier decision, "Aras teaches recording the payload data of the PID." (Id.) Because the payload data "has more information than the PID alone," the USPTO had previously concluded that "***there is no motivation to store the PID information of Aras.***" (Id.)

Fast forwarding to the instant application on appeal, we find that the Examiner previously rejected claim 13 as unpatentable over Aras in the Office actions of October 19, 2005 and June 15, 2006. The applicants pointed out to the Examiner of the instant application that the USPTO had previously correctly concluded that there was no motivation to modify Aras to collect and store PID headers because Aras already had access to the payload information. Faced with this inconsistency, the Examiner of the instant application replaced Aras with Houston, US Patent 6,353,939, in each of the rejections.

In response, the applicants pointed out that substituting Houston for Aras resulted in the exact same deficiency. In particular, because Houston teaches collecting ***payloads*** of packets associated with the PID headers for exactly the same reason the USPTO had

previously concluded that there was no motivation to modify Aras to collect the PID headers themselves, there was similarly no motivation to modify Houston to collect such PID headers. The Examiner, however, disagreed and maintained the rejections based on Houston. (See Office action dated August 1, 2007).

Faced with this intransigence of the Examiner and the inherent contradictions between the positions taken by the Examiner in this application and the conclusion reached by the USPTO in the earlier Massetti reexamination, the Applicants contacted John Houston, the named inventor of the Houston Patent, and asked him to evaluate the positions taken by the Examiner. Mr. Houston was available for contact because the Houston Patent has been assigned to the assignee of the instant application, and because John Houston was a paid consultant of the assignee. The Applicants sought Mr. Houston's candid view of the rejections based on the Houston Patent. As shown in the 132 Declaration submitted with the December 3, 2007 response, Mr. Houston affirmed that his patent neither disclosed nor suggested collecting PID headers as recited in claim 13. In particular, Mr. Houston testified:

> 5. With respect to independent claims 13, 61 and 79 of the '224 application as presented with the Response to the Office action of August 1, 2007 filed herewith, ***my patent makes absolutely no mention of collection and/or timestamping PID headers as a useful vehicle for performing media monitoring***. While it is true that the methods and apparatus disclosed in my patent could certainly collect such PID headers (the methods and apparatus I disclosed can be used to collect virtually any type of media measurement data), ***my patent does not specifically disclose the concept of collecting and/or timestamping such PID headers or in any way indicate that collecting and/or timestamping such PID headers would be of interest***. Therefore, in my opinion, ***the only way a person of ordinary skill in the art at the relevant time frame reading my patent would be led to collect and timestamp PID headers, is if that person had a priori knowledge of the value of collecting such PID headers from another source***.
>
> 6. I agree with the position that ***my patent described collecting payload data which may be associated with PID headers and, thus, my***

> ***patent does not by itself motivate someone to collect and timestamp PID headers***.

(132 Declaration of John Houston, Paragraphs 5 and 6)(bold & Italics added, underlining in original). Therefore, Mr. Houston unmistakably agreed that his patent, like Aras, did not "***motivate someone to collect and timestamp PID headers***." (Id. at Para. 6). This is completely consistent with the USPTO reexamination examiner's above discussed prior ruling in the Massetti reexamination that "there is no motivation to store the PID information of Aras in that the Aras system already has similar information (derived from the payload portion but not the PID per se)." (Control No. 90/007,057, Notice of Intent to Issue Ex Parte Reexamination Certificate dated April 3, 2006, Statement of Reasons for Patentability and/or Confirmation, Pages 12-13). Thus, the applicants have provided significant evidence that the invention of claim 13 was not obvious in view of the cited art. This evidence is further explained in the following.

The Houston/Ozkan Combination Fails to Meet Claim 13

As noted above, claim 13 is directed to a television audience measurement system comprising a software agent ***to read a program identification (PID) header*** from a data packet containing a portion of a tuned digital television program to identify the television program tuned by the digital television equipment, wherein the software agent ***stores at least a portion of the PID header in association with a timestamp***. The Office action rejected claim 13 based on a combination of Houston and Ozkan, US Patent 6,031,577. However, the combination of Houston and Ozkan is in error because it is not supported by logical motivations for making the same. Moreover, even if one were to combine Houston and

Ozkan, one would not arrive at the system of claim 13 as the Houston/Ozkan combination does not result in a system that stores at least a portion of a PID header in association with a timestamp.

Elements Missing From The Houston/Ozkan Combination

Houston discloses a cooperative media handler to present content to users and provide information about the presentation of that content and user interactions therewith to an audience measurement company. (See Houston, US Patent 6,353,929, Col 5, lines 5-63). However, Houston makes no mention whatsoever of PID headers or that collecting and timestamping such PIDs would be of any use. Indeed, as noted above, Houston himself testified that the Houston Patent "does not specifically disclose the concept of collecting and/or timestamping such PID headers or in anyway indicate that collecting and/or timestamping such PID headers would be of interest." (132 Declaration of John Houston, paragraph 5). Therefore, Houston does not teach or suggest a software agent that "stores at least a portion of the PID header in association with a timestamp" as recited in claim 13.

Ozkan, US Patent 6,031,577, is directed to "the formation of Program guides, system information and program specific information." (Ozkan, Col. 1, lines 13-15). Ozkan certainly uses PIDs, but they are used for tuning sub-channels. They are nowhere timestamped or in any way identified as something useful for audience measurement purposes. In the words of Ozkan:

> The corrected output data from unit 17 is processed by MPEG compatible transport processor and demultiplexer 22. The individual packets that comprise either particular program channel content, or program specific information, are ***identified by their Packet Identifiers (PIDs)***. Processor 22 separates data according to type based on an analysis of Packet Identifiers (PIDs) contained within packet header information and provides

synchronization and error indication information used in subsequent video, audio and data decompression.

The corrected output data provided to processor 22 is in the form of a transport datastream containing program channel content and program specific information for many programs distributed through several sub-channels. The program specific information in this exemplary description describes sub-channels present in a transport stream of a particular PTC. However, in another embodiment the program specific information may also describe sub-channels located in other PTCs and conveyed in different transport streams. Groups of these sub-channels may be associated in that their source is a particular broadcaster or they occupy the transmission bandwidth previously allocated to an analog NTSC compatible broadcast channel. Further, ***individual packets that comprise a selected program channel in the transport stream are identified and assembled by processor 60 operating in conjunction with processor 22 using PIDs*** contained in the program specific information.

The program specific information is in the form of hierarchically arranged tables including an MGT, CIT, EIT, and ETT together with supplementary descriptor information. The PID that identifies packets comprising the MGT data is predetermined and stored within processor 60 internal memory. Further, the MGT conveys the PIDs that identify the CIT, EIT, and ETT data and conveys other information indicating the size of these tables. Processor 60 monitors the MGT for updates to identify any changes in PIDs or table sizes. Therefore, after processor 60 determines from the FEC lock indication provided by unit 17 that valid data is being provided to transport processor 22, the MGT may be acquired without additional PID information. Using Control signal C, processor 60 configures transport processor 22 to select the data packets comprising the remaining program specific information including the CIT, EIT and ETT data. ***Processor 22 matches the PIDs of incoming packets provided by unit 17 with PID values pre-loaded in control registers within unit 22 by processor 60***. Further, processor 60 accesses, parses and assembles the program specific information packets captured by processor 22 and stores the program specific information within its internal memory. Processor 60 derives tuning parameters including PTC carrier frequency, demodulation characteristics, and sub-channel PIDs, from the acquired program specific information. ***Processor 60 uses this information in configuring units 13, 15, 17 and decoder 100 elements to acquire selected sub-channel (SC) program content***.

(Ozkan, Col. 5, lines 10-63)(emphasis added). Thus, Ozkan clearly recognizes the known presence of PIDs in digital television broadcasts and uses them for their convention tuning purposes. However, there is no mention of timestamping PIDs or transmitting PIDs to a

remote location for any audience measurement purpose. Thus, both Houston and Ozkan fail to teach or suggest a software agent that "stores at least a portion of the PID header in association with a timestamp" as recited in claim 13. Given that these same elements are missing from both Houston and Ozkan, the Houston/Ozkan combination likewise suffers from this same missing elements. Accordingly, the system of claim 13 is patentable over the Houston/Ozkan combination.

The False Motivations Cited by the Examiner

The Office action cites three alleged motivations for combining Houston and Ozkan to attempt to recreate the invention of claim 13. All three motivations are fanciful, inconsistent with the evidence of the state of the art at the time of the invention, and cannot be used to support the rejections of claim 13. The alleged motivations for combining Houston and Ozkan appear on Pages 9-10 of the Office action Mailed September 17, 2009 and are demonstrated to be false in the following.

The First False Motivation

The Examiner alleges:

> At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the PID headers taught by Ozkan in the system disclosed by Houston.
>
> The first motivation would have been that using a standardized program identifier, such as a PID header, would have given the system better interoperability with existing systems, which would be an advantage as Houston deals with the sharing of viewing records.

(Office action dates September 17, 2009, Page 9). This alleged motivation is almost incomprehensible in its vagueness. First of all, the motivation fails to identify any "existing systems" that lacked interoperability with Houston. It likewise fails to identify any way in which any alleged instance of this unknown and unidentified interoperability would actually be improved by collecting PIDs. Further, it fails to explain any way in which PIDs are standardized in a manner relevant to audience measurement generally or to the Houston system specifically. Further, it explains no way in which collecting PIDs with Houston would actually improve the sharing of viewing records and, thus, achieve the alleged "advantage." The soft and amorphous nature of this alleged motivation and its underlining statements is not surprising because they have no basis in fact.

As explained above, PID headers are used for distinguishing packets for minor channels that are broadcast together in a major channel. While they are standardized in the sense that they are defined as a certain 13 bits in the header of broadcast digital television packets, it is far from clear that this standardization has any bearing on Houston or the audience measurement Houston seeks to perform. On the contrary, as known to those of ordinary skill in the digital television art, PIDs are not intended to distinguish between programs from time to time or across major channels. Thus, there is no standardization of PIDs in a sense that would suggest they are useful for audience measurement. Moreover, there is nothing in Houston to suggest that there is any lack of interoperability that would be addressed by collecting PID headers. Indeed, it is important to note that the Houston system contemplated monitoring satellite television (i.e., digital, packetized television broadcasts). (Houston, USP 6,353,929 at Col. 4, lines 23-28). Despite the fact that the Houston system was adapted to measure digital television broadcasts, the inventor, John Houston himself,

testified, "Therefore, in my opinion, the only way a person of ordinary skill in the art at the relevant time frame reading my patent would be led to collect and timestamp PID headers, is if that person had a priori knowledge of the value of collecting such PID headers from another source." (132 Declaration of Houston, paragraph 5).

Ozkan does not provide any such a priori knowledge. As discussed above Ozkan uses PIDs, but for their conventional tuning purpose. There is no indication in Ozkan that PIDs should be timestamped or that they have any value for audience measurement purposes.

In short, the alleged "first motivation" is completely without basis in fact. On the contrary, it is naked conjecture that pales to inconsequence in view of the solid evidence provided by the applicants. The KSR decision of the US Supreme Court did not give examiners license to reject claims based on artificially manufactured motivations. While Examiners are certainly to use common sense in making patentability determinations, they are not to depart from reality nor are they to require applicants to tilt with the windmills of the examiner's imagination in order to prove their entitlement to a patent. This first motivation is nothing more than the product of a creative mind using knowledge of the invention to seek a reason to patch references together for the sole reason of rejecting a claim. It is not the product of common sense reasoning that would have been employed by a person of ordinary skill in the art at the time of the invention and it is not a proper basis for rejecting claim 13.

The Second False Motivation

The Examiner alleges:

> The second motivation would have been that using the PID header enables the system to tune to a sub-channel without acquiring the program map table (PMT)(Ozkan, column 7, lines 47-54).

(Office action dates September 17, 2009, Page 9). This statement betrays a superficial understanding of the Houston and Ozkan Patents that would not have characterized the person of ordinary skill in the art. First of all and as explained above, the use of PIDs is fundamental to tuning of digital programming. As also mentioned above, Houston monitored digital television broadcasts. (Houston, USP 6,353,929 at Col. 4, lines 23-28). As such, the systems Houston monitored were quite capable of tuning to sub-channels apart from any need to reference Ozkan. Further, Houston is directed to a system for monitoring exposure to media. It is not directed to a system to tune such media. As such, a person of ordinary skill in the art reviewing the audience measurement system of Houston would not be looking for ways to improve the operation of the tuning systems Houston monitors and, thus, would never be incentivized by the second alleged motivation. In the words of Mr. Houston himself:

> My patent is directed toward an audience measurement system. It is not a tuning device and it does not seek to affect how audience members utilize their tuning devices nor does it seek to affect how such tuning devices operate to tune programs. Instead, specifically with respect to tuning devices, my patent relates to measuring how audience members utilize their own tuning devices. ***As such, there is no reason apparent to me to modify my patent to enable tuning of any sort, let alone to enable tuning "to sub-channels without acquiring the program map table (PMT)" as stated in the Office action***.

(132 Declaration of John Houston, Paragraph 3)(emphasis added).

Second, while Ozkan is certainly directed to modifying tuning systems to tune to a sub-channel without acquiring the program map table (PMT), Ozkan does NOT do this by introducing PIDs. Rather, Ozkan assumes that PIDs are present, since as explained above, PIDs are an inherent requirement of the digital broadcasting system. Rather, Ozkan is

directed to utilizing a Service Location Descriptor map in place of a Program Map Table to achieve more efficient tuning. In the words of Ozkan:

> The SLD program map information replicates information already present within the Program Map Table (PMT) segment of the MPEG compatible transport stream input to decoder 100. However, ***by incorporating the SLD within the CIT, the time required by decoder 100 to identify and acquire a program being transmitted on selected sub-channel SC is advantageously reduced***. This is because the CIT and SLD provide formatted and linked information sufficient to enable processor 60 to directly configure and tune the system of FIG. 1 to receive the selected sub-channel SC. Specifically, ***the CIT and SLD directly associate individual first and second sub-channel identification numbers with the PIDs for identifying the datastreams that constitute a program being conveyed on this sub-channel***. This enables processor 60 to configure the system of FIG. 1 to receive the selected sub-channel SC without acquiring and using the Program Map Table (PMT) information in the MPEG compatible transport stream input to decoder 100. In addition, the data partitioning, data formatting and data repetition frequency characteristics of the CIT and SLD program map information may be determined independently of the requirements of MPEG PMT information.

(Ozkan, Col. 7, lines 37-58)(emphasis added). Thus, rather than introducing PIDs as suggested by the Examiner in the alleged second motivation, Ozkan makes no modifications to PIDs, but instead develops a new tuning (SLD) table to be used in place of a PMT in a digital tuner. As such, although Ozkan is certainly focused on improving tuning in a digital television system, it has absolutely no teaching on how to improve the audience measurement system of Houston. In short, Houston and Ozkan are just two ships passing in the night. While they both are afloat in the digital television space, Ozkan has no reasonable bearing on the Houston measurement system.

Importantly, the Ozkan system makes no mention of ***timestamping*** PIDs. As such, even were one to employ Ozkan's tuning approach in the digital television system monitored by Houston, one would not arrive at a system including a software agent that stores at least a portion of the PID header in association with a timestamp as recited in claim 13.

The Third False Motivation

The Examiner alleges:

> The third motivation refers to KSR, where a claimed improvement on a device or apparatus is no more than "the simple substitution of one known element for another or the mere application of a known technique to a piece of prior art ready for improvement," the claim is unpatentable. Accordingly, Applicant claims a combination that only unites old elements with no change in the respective functions in those old elements and the combination of those elements yields predicable results; absent evidence that the modification necessary to effect the combination of elements is uniquely challenging or difficult for one of ordinary skill in the art, the claim is unpatenable.

(Office action dates September 17, 2009, Page 9). This third alleged motivation does not fit the facts at hand. First of all, no art of record teaches or suggests timestamping PIDs. Therefore, timestamped PIDs have NOT been shown to be a known element. Accordingly, it is quite impossible for claim 13 to present a situation involving the "simple substitution of one ***known*** element for another." Similarly, it has been convincingly shown that neither Houston nor Ozkan teaches timestamping of PIDs. As such, claim 13 does not present a situation of the "mere application of a ***known*** technique to a piece of prior art ready for improvement." Furthermore, there has been no showing that Houston is "ready for improvement," or that Applicant claims a combination that only unites old elements with no change in the respective functions in those old elements and the combination of those elements yields predicable results." However, this too is completely false. As noted above, neither Houston nor Ozkan in anyway contemplate timestamped PIDs or in any way indicate that such PIDs can be given a new function for audience measurement. As such, claim 13 is NOT merely uniting old elements with no change in the respective functions in those old elements as incorrectly alleged by the third motivation. Furthermore, the combination of claim 13 yields unpredictable results. As noted above, PIDs are intended to enable a tuner to

distinguish between multiplexed program streams received at a given moment in time, but ***do not themselves distinguish between programs from time to time or across major channels***. As such, at the time of the invention, it was far from predictable that timestamping PIDs would have an advantage in an audience measurement application such as the Houston system which seeks to universally identify programs across multiple channels to provide useful and reliable exposure data and/or ratings. Indeed, the best evidence of this lack of predictability is the testimony of Mr. Houston himself who indicated that, while the methods and apparatus he disclosed "can be used to collect virtually any type of media measurement data," his patent nevertheless does not suggest any need to timestamp PIDs. (132 Declaration of John Houston, Paragraph 5). In the words of Mr. Houston, "my patent does not … ***in anyway indicate that collecting and/or timestamping such PID headers would be of interest***." (Id.)(emphasis added). Therefore, while the Office has provided NO evidence of predictability, the Applicants have provided the testimony of the inventor of the primary reference relied upon in the rejection demonstrating that, despite the comprehensive nature of that prior art reference, it still did not predict any use or value to timestamping PIDs as recited in claim 13. Therefore, not only is the third alleged motivation based on false assumptions, it is unsupported by any credible evidence.

As demonstrated above, the rejection of claim 13 is based on multiple errors. In particular, the rejection of claim 13 must be withdrawn because:

(1) the Houston/Ozkan combination results in at least one missing element; and/or

(2) the three alleged motivations to combine Houston and Ozkan are based on factual errors, are inconsistent with the issues presented by claim 13, are unsupported by any credible evidence, and are refuted by evidence of record.

Accordingly, the rejections of claim 13 and all claims depending therefrom must be reversed.

B. The Art Does Not Teach Timestamping PIDs As Recited In Claim 61

Claim 61 recites a ***tangible computer-readable storage medium*** including a set of instructions which, when executed by a computer, provide ***a software agent stored in memory associated with digital television equipment***, wherein the software agent is arranged to acquire television audience measurement data relative to the digital television equipment, the software agent comprising ***first instructions to store and timestamp at least a portion of a television program identification (PID) header*** from a data packet containing a portion of a tuned television program to identify the television program selected for viewing on the digital television equipment. The Office action rejects claim 61 on the same art and similar reasoning as it rejected claim 13. (See Office action dated September 17, 2009, Pages 13-14). In particular, the Office action relies on the Houston/Ozkan combination and the first two of the three alleged motivations applied in rejecting claim 13. (Id.) As discussed in detail above, neither Houston nor Ozkan teach or suggest storing and timestamping PIDs. Accordingly, the Houston/Ozkan combination does not result in first instructions to store and timestamp at least a portion of a television program identification (PID) header as recited in claim 61. Further, as demonstrated above, the alleged motivations to combine Houston and Ozkan are based on factual errors, inconsistent with the issues presented by claim 61, unsupported by any credible evidence, and refuted by evidence of record. Accordingly, the rejections of claim 61 and all claims depending therefrom must be reversed.

C. The Art Does Not Teach Timestamping PIDs As Recited In Claim 79

Claim 79 recites a method implemented by a software agent ***stored in memory associated with digital television equipment***, wherein the software agent is arranged to acquire television audience measurement data relative to the digital television equipment, the method comprising: ***storing and time stamping at least a portion of a television program identification (PID) header*** from a data packet containing a portion of a tuned television program to identify the television program selected for viewing on the digital television equipment. The Office action rejects claim 79 on the same grounds as claim 61. (See Office action dated September 17, 2009, Page 15). As discussed in detail above. the grounds for rejecting claim 61 are in error. Accordingly, for at least the same reasons the rejections of claim 61 and all claims depending therefrom must be reversed, the rejections of claim 79 and all claims depending from claim 79 must likewise be reversed.

Ground 2. Claims 62-69, 80-87, 94 and 102 are patentable over the Houston/Welsh/Saito combination

A. Houston/Welsh/Saito is missing at least one element of Claim 62

Independent claim 62 recites an apparatus for identifying a viewer selected television program received by digital television program reception equipment, wherein ***the digital television program reception equipment has a data port*** to export tuned data. The apparatus of claim 62 specifically comprises a <u>reader</u> ***connected to the data port*** <u>to read program identifying data</u> tuned by the digital television program reception equipment <u>from among data exported from the digital television program reception equipment via the data port</u> ***for use by a media device different from the digital television program reception equipment.*** Thus, the plain language of claim 62 identifies three devices, namely, (1) the digital television program reception equipment, (2) the reader, and (3) a media device different from

the digital television program reception equipment. Further, claim 62 points out that the reader is "***connected to the data port***" of the digital television program reception equipment. Significantly, claim 62 requires the reader to read program identifying data from among data exported via the data port. Importantly, the data exported via the data port is intended for use "by a media device different from the digital television program reception equipment." Thus, the plain and clear meaning of claim 62 is that the reader reads (i.e., intercepts or eavesdrops on) data exported from the digital television program reception equipment to a media device different from the digital television program reception equipment.

The Final Office action rejected independent claim 62 as unpatentable over Houston, in view of Welsh, U.S. Patent 5,374,951, and further in view of Saito, U.S. Patent 6,751,221. The Final Office action sums up the rejection as follows:

> The rejection used is Houston teaching a viewer history record storing, which is combined with Welsh to teach a slave unit for storing a viewer history record being connected by a wire, which is then combined with Saito to teach where the wire could be a firewire cord.

(Office action dates September 17, 2009, Page 7). It is immediately clear from the Examiner's summation of his rejection that the Houston/Welsh/Saito combination involves ***only two devices***, namely, the master (Houston) device and the slave (Welsh) device. Saito is provided merely to make the connection between these two devices a firewire connection. Thus, it is likewise immediately clear that the master/slave system of the Houston/Welsh/Saito combination does not meet the recitations of claim 62.

For example, claim 62 recites three devices, not two. Presumably, the Examiner intends the Houston (master) device to be analogous to the digital television program reception equipment of claim 62, and the Welsh (slave) device to be analogous to the reader

of claim 62. However, even in this reading, the Welsh (slave) device would not read program identifying data ***from among data exported from the digital television program reception equipment*** via the data port ***for use by a media device different from the digital television program reception equipment*** as required by claim 62. In other words, there is no reasonable way to read the Welsh slave device as a device that reads data from data intended for use by a media device different from the digital television program reception equipment. Quite simply, Welsh does not in any way contemplate intercepting data communicated between two other devices as required in claim 62. Saito does not change this fact, but instead is only relied upon to indicate the master/slave communication between Houston and Welsh could be IEEE 1394 protocol communications. Therefore, the Houston/Welsh/Saito combination fails to meet at least one recitation of claim 62. For example, the Houston/Welsh/Saito combination does not teach or suggest ***a reader*** connected to the data port ***to read program identifying data*** tuned by the digital television program reception equipment ***from among data exported from the digital television program reception equipment*** via the data port ***for use by a media device*** different from the digital television program reception equipment. Accordingly, the rejections of claim 62 and all claims depending therefrom are based on reversible error.

Furthermore, it flatly makes no sense to attempt to convert Houston into a system such as claim 62. As explained by Mr. Houston himself:

> 4. The cooperative media handler methods disclosed in my patent provide access to a rich amount of audience measurement data, so there is nothing to be gained by employing eavesdropping methods such as those disclosed in the ‘224 application [i.e., the application on appeal] when my disclosed methods are available. Therefore, in my opinion, a person of ordinary skill in the art reading my patent in the

> relevant time frame would not be led by my disclosure to the invention recited in claims 62 and 80 of the '224 application as currently presented in the response to the Office action of August 1, 2007 filed herewith. ***Quite simply, the techniques I disclose and the techniques recited in claims 62 and 80 relate to fundamentally different approaches to media measurement. Since my patent has no need of eavesdropping techniques such as those recited in claims 62 and 80, in my opinion, no person of ordinary skill in the art reading my patent would take it as suggesting the eavesdropping techniques of the '224 application.***

(Houston Declaration, Paragraph 4)(emphasis added).

The Office action proposes a master/slave device configuration based on Houston and Welsh and further contends that the communications between Houston and Welsh could be done in accordance with the IEEE 1394 firewire protocol. However, using the firewire protocol for upstream communication might result in exporting the data collected ***within the monitored device*** by the Houston cooperative media handler, but it provides ***no rationale for completely changing the data collection mechanism of Houston*** from a software agent <u>internal</u> to a monitored media presentation device to a reader that eavesdrops on communications to a second media device to collect program identification tags output via the firewire port of the monitored media presentation device. In other words, the motivation proposed by the Office action *might* lead one to forward the data collected internally by the Houston software agent upstream to the central data collection center, ***but it would not lead one to replace the inventive Houston data collection mechanism with an external reader to intercept data for a second media device as*** recited in claim 62.

In short, it is clear that none of Welsh, Houston or Saito contemplate using a reader coupled to an IEEE 1394 data port to eavesdrop to collect program identification tags from data communicated to a second media device. Indeed, given Houston's access to detailed

audience measurement information ***within*** the monitored equipment via the cooperative media handler, there is no need for a reader coupled to an IEEE 1394 port of the monitored equipment to record identifier tags exported via the IEEE 1394 port of the monitored equipment. Therefore, the only reason anyone would read the Houston/Welsh/Saito combination as teaching such an external reader is with a priori knowledge of the invention of claim 62. Of course, such hindsight usage of the teachings of the Applicants' invention is not a proper basis for rejecting the Applicants' claims. Accordingly, the rejections of claim 62 and all claims depending therefrom must be reversed.

B. Houston/Welsh/Saito is missing at least one element of Claim 80

Independent claim 80 recites a method for identifying a viewer selected television program from among a plurality of time overlapped television programs broadcast in a viewer selected broadcast channel and received by digital television program reception equipment, wherein ***the digital television program reception equipment has a data port to export tuned data to a second media device***, the method comprising ***intercepting program identifying data*** tuned by the digital television program reception equipment ***from among data exported from the digital television program reception equipment*** via the data port, wherein the data port operates in accordance with the IEEE 1394 protocol, the program identifying data includes identifier tags exported with the data in accordance with the IEEE 1394 protocol, and ***the program identifying data is exported to the second media device***. Thus, the plain language of claim 80 requires ***interception*** of data exported from digital television program reception equipment to a second media device. The Final Office action

appears to have completely ignored this plain language in rejecting claim 80 based on Houston/Welsh/Saito. In particular, the Final Office action states:

> The applicant cited [sic, citing] the Houston Declaration states that as the Houston patent does not mention eavesdropping, that it can't be used in combination to reject the limitation. ***As the claims only refer to connecting up an external reader and not eavesdropping, this argument is moot***.

(Office action dates September 17, 2009, Page 6)(emphasis added). However, there is no apparent difference between "intercepting" a communication and "eavesdropping" on a communication. Therefore, it is plain that the Examiner has committed reversible error by ignoring the plain language of claim 80.

As discussed above in connection with claim 62, the Houston/Welsh/Saito combination does not teach or suggest intercepting program identifying data from among data exported from digital television program reception equipment to a second media device. Nor, given the testimony of Mr. Houston and the teachings of the Houston patent itself, is there any credible reason to believe it would have been obvious to replace the ***inventive*** Houston data collection mechanism <u>internal</u> to a media device with an external reader to intercept data for a second media device as recited in claim 80. Accordingly, the rejections of claim 80 and all claims depending therefrom, must be reversed.

In view of the foregoing remarks, it is respectfully submitted that all of the rejections made in the final Office action are fatally flawed and must be overturned.

Respectfully submitted,

HANLEY, FLIGHT & ZIMMERMAN, LLC.
Suite 2100
150 South Wacker Drive
Chicago, Illinois 60606
(312) 580-1020

By: /James A Flight/
James A Flight
Registration No. 37,622

October 18, 2010

VIII. Claims Appendix

1-12. (Cancelled)

13. A television audience measurement system for digital television equipment, wherein the digital television equipment is disposed in a statistically selected location, the television audience measurement system comprising:

a software agent adapted to read a program identification (PID) header from a data packet containing a portion of a tuned digital television program to identify the television program tuned by the digital television equipment, wherein the software agent is stored in memory associated with the digital television equipment and the PID header is broadcast with the data packet to enable the digital equipment to tune to a selected one of a plurality of minor channels broadcast in a major channel, wherein the software agent stores at least a portion of the PID header in association with a timestamp; and

a communication apparatus adapted to transmit at least one of the at least the portion of the PID header and media identification information obtained via the PID header to a remotely located central office.

14. The television audience measurement system of claim 13 wherein the digital television equipment comprises a receiver having a tuner, a microprocessor, memory, an operating system, and a video display unit.

15. The television audience measurement system of claim 13 wherein the digital television equipment is a set top box providing an analog television signal to an analog receiver.

16. The television audience measurement system of claim 13 wherein the digital television equipment comprises a set top box providing a digital television signal to a digital receiver.

17. The television audience measurement system of claim 13 wherein the digital television equipment comprises a set top box and a monitor.

18. The television audience measurement system of claim 13 wherein the digital television equipment comprises a personal computer provided with a television receiver.

19. The television audience measurement system of claim 13 wherein the digital television equipment includes a VCR.

20. The television audience measurement system of claim 13 wherein the digital television equipment includes a digital versatile disk player.

21. The television audience measurement system of claim 13 further comprising a person identification apparatus.

22-27. (Cancelled)

28. The television audience measurement system of claim 13 wherein the software agent is arranged to detect window activities conducted by an audience.

29. The television audience measurement system of claim 13 wherein the communication apparatus includes a serial port.

30. The television audience measurement system of claim 13 wherein the communication apparatus includes a parallel port.

31. The television audience measurement system of claim 13 wherein the communication apparatus includes a universal serial bus.

32. The television audience measurement system of claim 13 wherein the communication apparatus includes a firewire port.

33. The television audience measurement system of claim 13 wherein the communication apparatus is arranged to send the PID header to an Internet service provider via the Internet.

34. The television audience measurement system of claim 13 wherein the communication apparatus includes an intermediate data collector.

35. The television audience measurement system of claim 34 wherein the intermediate data collector includes a store and forward device, and wherein the store and forward device is arranged to send the PID header to the central office via a telephone line.

36. The television audience measurement system of claim 34 wherein the intermediate data collector is an Internet service provider.

37. The television audience measurement system of claim 34 wherein the intermediate data collector is a data collection facility located in the central office.

38. The television audience measurement system of claim 13 wherein the software agent is a software agent downloaded to the memory associated with the digital television equipment.

39. The television audience measurement system of claim 13 wherein the software agent is a plug in software agent of the digital television equipment.

40-60. (Cancelled)

61. A tangible computer-readable storage medium including a set of instructions which, when executed by a computer, provide a software agent stored in memory associated with digital television equipment, wherein the software agent is arranged to acquire television

audience measurement data relative to the digital television equipment, the software agent comprising:

first instructions to store and timestamp at least a portion of a television program identification (PID) header from a data packet containing a portion of a tuned television program to identify the television program selected for viewing on the digital television equipment;

second instructions to log a co-transmitted datum transmitted in a same major channel as the television program selected for viewing on the digital television equipment, the co-transmitted datum being related to the tuned television program; and,

third instructions to log an Internet identification datum associated with an Internet task of the digital television equipment.

62. An apparatus for identifying a viewer selected television program from among a plurality of time overlapped television programs broadcast in a viewer selected broadcast channel and received by digital television program reception equipment, wherein the digital television program reception equipment has a data port to export tuned data, the apparatus comprising:

a reader connected to the data port to read program identifying data tuned by the digital television program reception equipment from among data exported from the digital television program reception equipment via the data port for use by a media device different from the digital television program reception equipment, wherein the data port operates in accordance with the IEEE 1394 protocol and the program identifying data read by the reader are identifier tags exported with the data in accordance with the IEEE 1394 protocol; and,

a memory to store the program identifying data.

63. The apparatus of claim 62 wherein the digital television program reception equipment is a digital converter.

64. The apparatus of claim 62 wherein the digital television program reception equipment is a personal computer.

65. The apparatus of claim 62 wherein the digital television program reception equipment is a digital television set.

66. The apparatus of claim 62, further comprising a communication device to transfer the program identifying data to a remote point.

67. The apparatus of claim 66 wherein the digital television program reception equipment is a digital converter.

68. The apparatus of claim 66 wherein the digital television program reception equipment is a personal computer.

69. The apparatus of claim 66 wherein the digital television program reception equipment is a digital television set.

70-78. (Cancelled)

79. A method implemented by a software agent stored in memory associated with digital television equipment, wherein the software agent is arranged to acquire television audience measurement data relative to the digital television equipment, the method comprising:

storing and time stamping at least a portion of a television program identification (PID) header from a data packet containing a portion of a tuned television program to identify the television program selected for viewing on the digital television equipment;

logging a co-transmitted datum transmitted in a same major channel as the television program selected for viewing on the digital television equipment, the co-transmitted datum being related to the tuned television program; and,

logging an Internet identification datum associated with an Internet task of the digital television equipment.

80. A method for identifying a viewer selected television program from among a plurality of time overlapped television programs broadcast in a viewer selected broadcast channel and received by digital television program reception equipment, wherein the digital television program reception equipment has a data port to export tuned data to a second media device, the method comprising:

intercepting program identifying data tuned by the digital television program reception equipment from among data exported from the digital television program reception equipment via the data port, wherein the data port operates in accordance with the IEEE 1394

protocol, the program identifying data includes identifier tags exported with the data in accordance with the IEEE 1394 protocol, and the program identifying data is exported to the second media device; and,

storing the program identifying data.

81. The method of claim 80 wherein the digital television program reception equipment is a digital converter.

82. The method of claim 80 wherein the digital television program reception equipment is a personal computer.

83. The method of claim 80 wherein the digital television program reception equipment is a digital television set.

84. The method of claim 80, further comprising communicating the program identifying data to a remote point.

85. The method of claim 84 wherein the digital television program reception equipment is a digital converter.

86. The method of claim 84 wherein the digital television program reception equipment is a personal computer.

87. The method of claim 84 wherein the digital television program reception equipment is a digital television set.

88. The television audience measurement system of claim 13 wherein the communication apparatus transmits the time stamps to the remotely located central office to facilitate compilation of audience measurement data.

89. The television audience measurement system of claim 13 wherein the communication apparatus is an output port of the digital television equipment.

90. The television audience measurement system of claim 89 wherein the output port outputs data in accordance with the IEEE 1394 protocol.

91. (Cancelled)

92. The software agent of claim 61 wherein the digital television equipment includes an output port to export at least one of the time stamped PID header, the co-transmitted datum, or the Internet identification datum.

93. The software agent of claim 92 wherein the output port outputs data in accordance with the IEEE 1394 protocol.

94. The apparatus of claim 62 wherein the reader time stamps the program identifying data.

95. (Cancelled)

96. (Cancelled)

97. (Cancelled)

98. (Cancelled)

99. The method of claim 79 further comprising exporting at least one of the time stamped PID header, the co-transmitted datum, or the Internet identification datum from the digital television equipment via an output port operating in accordance with the IEEE 1394 protocol.

100. The method of claim 80 further comprising time stamping the program identifying data.

101. (Cancelled)

102. The method of claim 84 further comprising time stamping the program identifying data.

103. (Cancelled)

IX. <u>Evidence Appendix</u>

The evidence relied upon is reflected in the following table.

Reference	Entered in Record
Houston, US Patent 6,353,929	Relied upon to reject the claims on appeal in the Final Office Action. Entered in the record by the Examiner on PTO-892 dated October 19, 2005.
Ozkan, US Patent 6,031,577	Relied upon by the Examiner to reject the claims on appeal in the Final Office Action. Entered in the record by the Examiner on PTO-892 dated June 15, 2006.
Welsh, US Patent 5,374,951	Relied upon to reject the claims on appeal in the Final Office Action. Entered in the record by the Examiner on PTO-892 dated February 6, 2009.
Saito, US Patent 6,751,221	Relied upon to reject the claims on appeal in the Final Office Action. Entered in the record by the Examiner on PTO-892 dated June 15, 2006.

132 Declaration of Houston	Provided in Response dated December 3, 2007 discussed by the Examiner in non-final rejection mailed February 6, 2009.

X. **Related Proceedings Appendix**

None.

US006353929B1

(12) **United States Patent**
Houston

(10) **Patent No.: US 6,353,929 B1**
(45) **Date of Patent: *Mar. 5, 2002**

(54) **COOPERATIVE SYSTEM FOR MEASURING ELECTRONIC MEDIA**

(75) Inventor: **John S. Houston**, New York, NY (US)

(73) Assignee: **One River Worldtrek, Inc.**, New York, NY (US)

(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **08/880,371**

(22) Filed: **Jun. 23, 1997**

(51) **Int. Cl.**^{7} **H04N 7/16**; G06F 9/44

(52) **U.S. Cl.** **725/20**; 725/9; 709/217; 709/302; 705/7

(58) **Field of Search** 348/473, 563, 348/461, 1–200; 709/210–220; 455/2; 725/9–31; 711/1–200; 705/1–45

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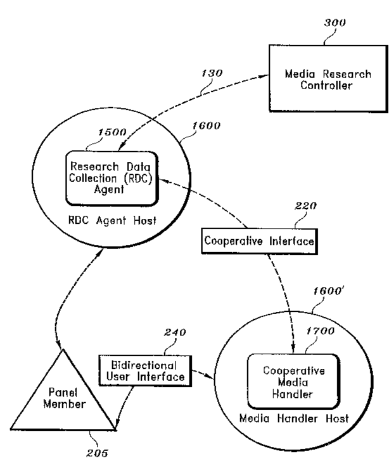
Primary Examiner—Andrew Faile
Assistant Examiner—Reuben M. Brown
(74) *Attorney, Agent, or Firm*—Ryan, Mason & Lewis, LLP

(57) **ABSTRACT**

A cooperative electronic media measurement system is disclosed which uses media handlers to obtain information from, or otherwise obtain information about, presented media objects, including identification tags, if present, for collection by research data collection agents and subsequent dispatch to a centralized media research controller. The media research controller registers advertisements and other media for subsequent measurement and provides a unique identification tag that may be added to, or associated with, the existing media object. Media objects are presented to a panel member by a panel member-computing device which may receive media objects by means of a network connection, from one or more local sources, or generate media objects in real-time, or a combination thereof. One or more research data collection agents are assigned to measure each panel member's exposure to and interactions with electronic media. Cooperative media handlers automatically obtain information from, or otherwise obtain information about, presented media objects including identification tags, if present, and other information, for collection by the research data collection agents. A research data collection agent will track a panel member, and collect such transmissions from the cooperative media handlers, when a panel member is in the scope of the research data collection agent. The research data collection agent (i) creates log entry objects from transmissions received from the cooperative media handlers and places the log entry objects into an unfiltered media queue, (ii) confirms the integrity of the messages and filters out unnecessary log entry objects from the unfiltered media queue to create a filtered media queue, (iii) creates dispatch objects using objects from the filtered media queue and places created dispatch objects into a dispatch queue, and (iv) transmits dispatch objects from the dispatch queue to the media research controller, when resources are available.

126 Claims, 23 Drawing Sheets



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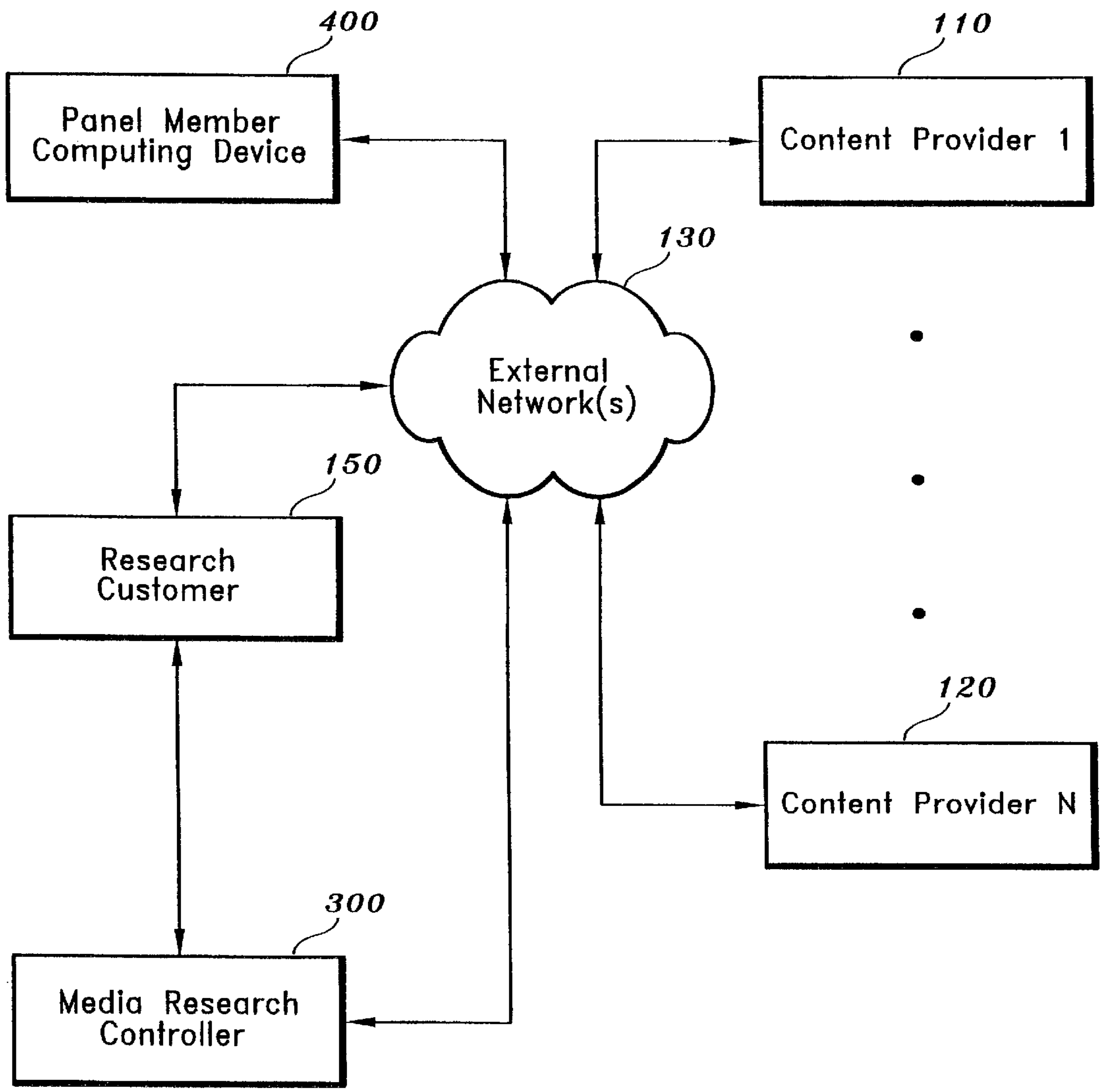

400
Panel Member Computing Device
110
Content Provider 1
130
External Network(s)
150
Research Customer
120
Content Provider N
300
Media Research Controller

FIG. 1

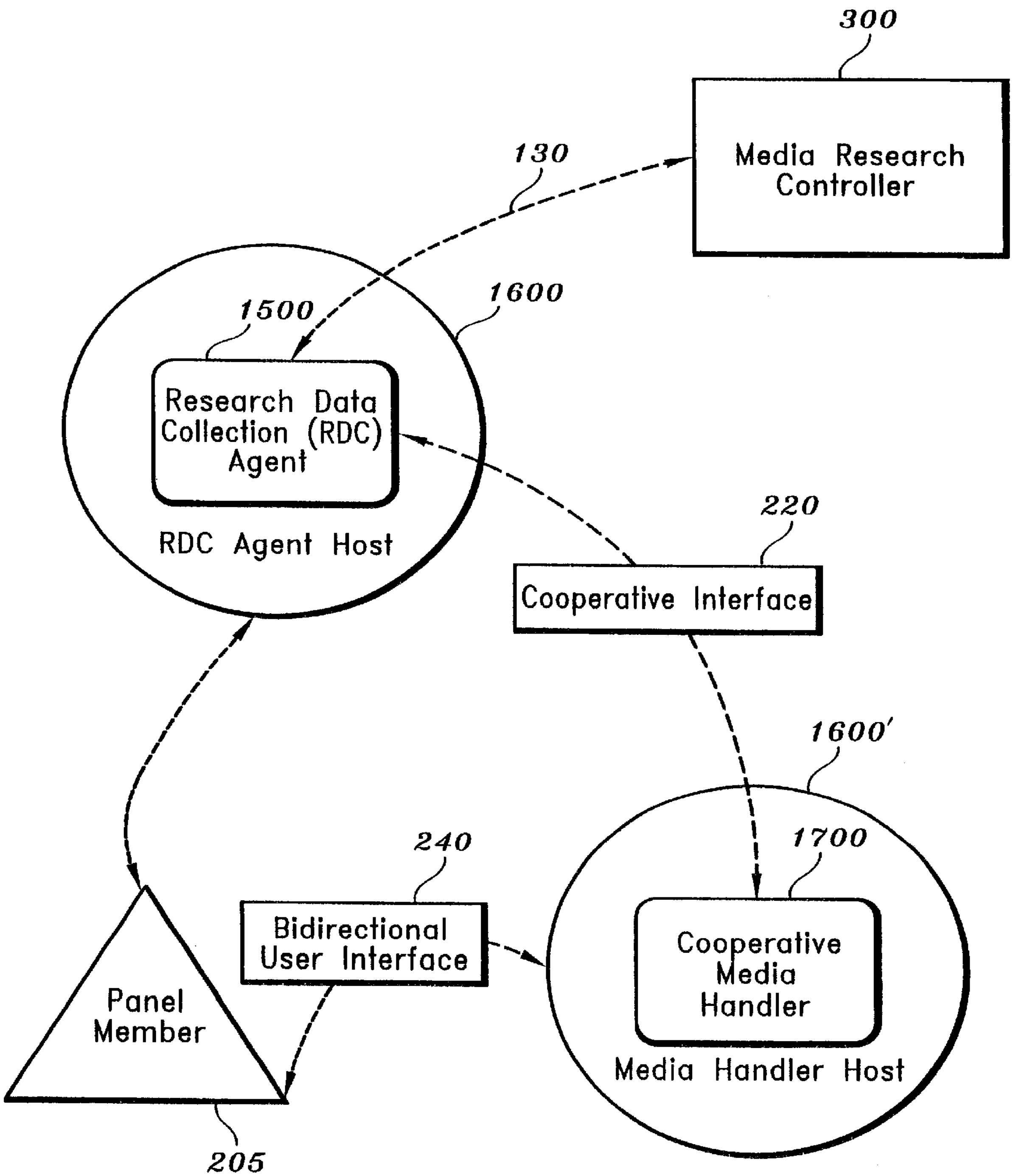

300
Media Research Controller
130
1600
1500
Research Data Collection (RDC) Agent
RDC Agent Host
220
Cooperative Interface
1600'
1700
240
Bidirectional User Interface
Cooperative Media Handler
Media Handler Host
Panel Member
205

FIG. 2

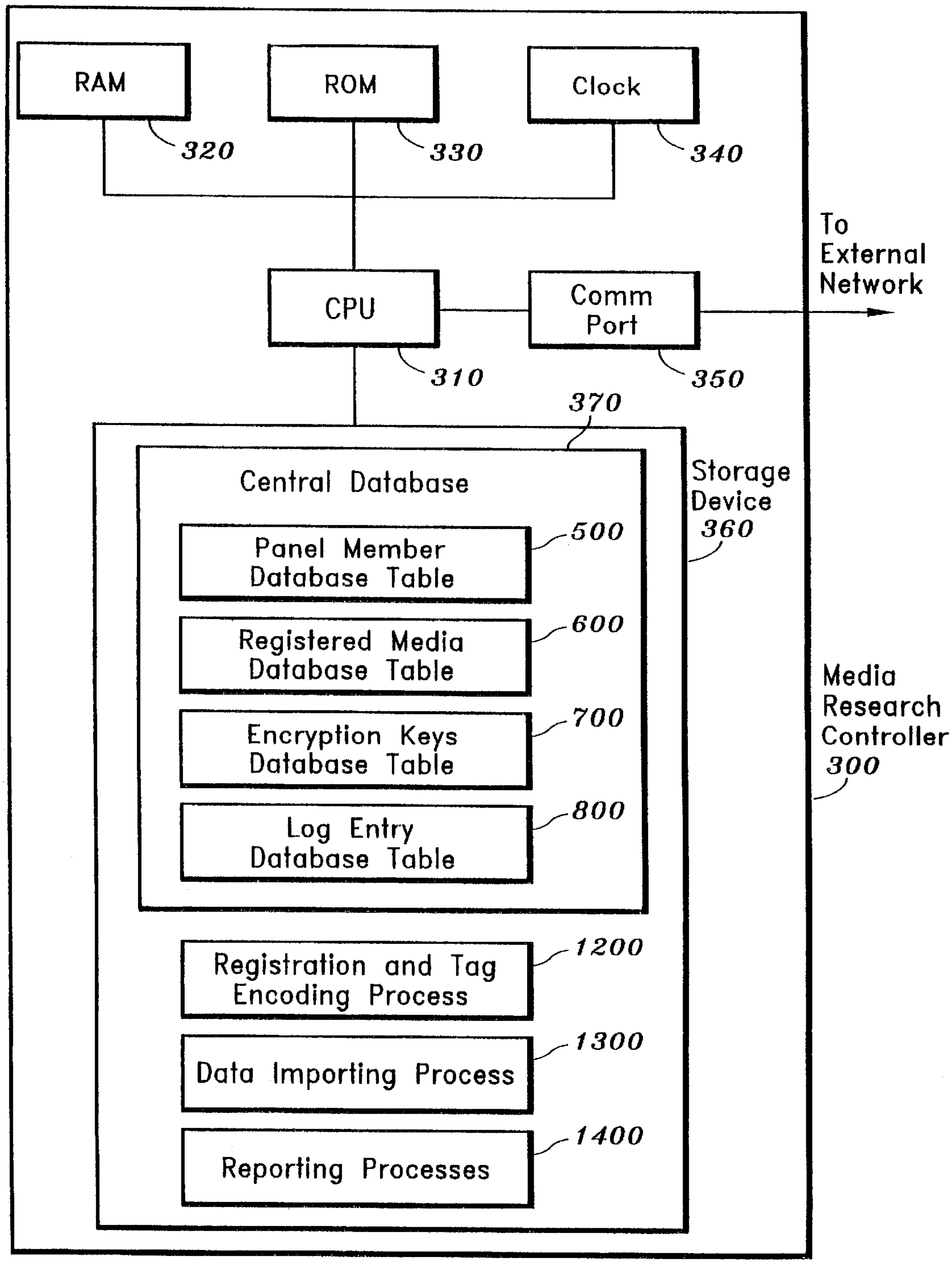
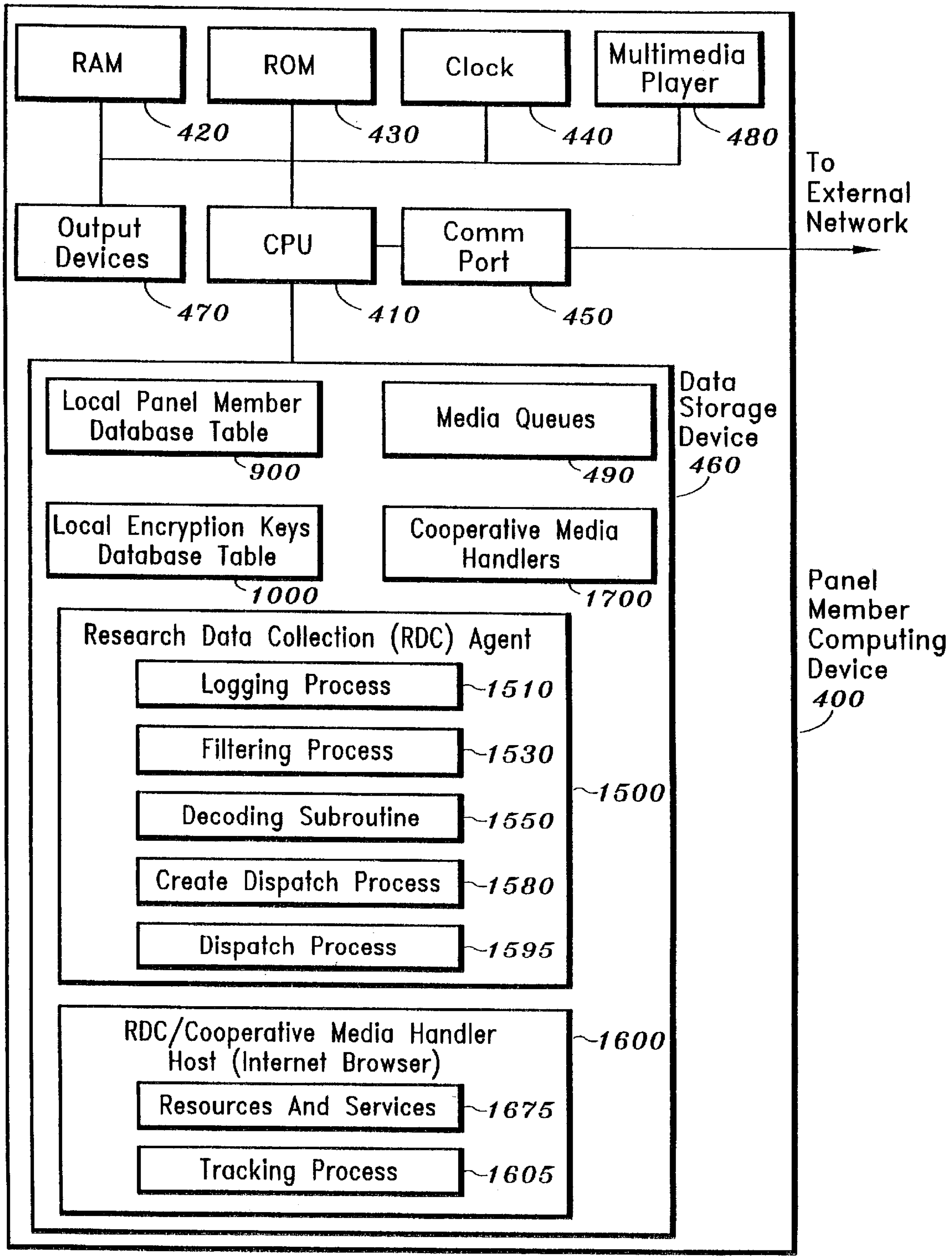

RAM
320
ROM
330
Clock
340
To
External
Network
CPU
310
Comm
Port
350
370
Central Database
Storage
Device
360
Panel Member
Database Table
500
Registered Media
Database Table
600
Encryption Keys
Database Table
700
Log Entry
Database Table
800
Media
Research
Controller
300
Registration and Tag
Encoding Process
1200
Data Importing Process
1300
Reporting Processes
1400

FIG. 3

FIG. 4



RAM
ROM
Clock
Multimedia Player
420
430
440
480
To External Network
Output Devices
CPU
Comm Port
470
410
450
Local Panel Member Database Table
Media Queues
Data Storage Device
460
900
490
Local Encryption Keys Database Table
Cooperative Media Handlers
1000
1700
Panel Member Computing Device
400
Research Data Collection (RDC) Agent
Logging Process
1510
Filtering Process
1530
Decoding Subroutine
1550
1500
Create Dispatch Process
1580
Dispatch Process
1595
RDC/Cooperative Media Handler Host (Internet Browser)
1600
Resources And Services
1675
Tracking Process
1605

FIG. 5: PANEL MEMBER DATABASE TABLE

	540	545	550	555	560	565	570	575	580	585
	Panel Member ID	Name	Sex	Age	City	State	Education	Income	Primary RDC Agent	Email Address
505	37121	Jason Green	M	36	New York	NY	College Grad	$120,000.00	RDCA50101	jg121@aol.com
510	37122	Jessica Green	F	35	New York	NY	Post Grad	$ 80,000.00	RDCA50101	jessica21@aol.com
515	37123	Jasper Green	M	8	New York	NY	Primary	$ -	RDCA50101	terak@aol.com
520	41023	Mark Hillerman	M	28	Burlington	VT	College Grad	$ 57,000.00	RDCA52777	markhill@msn.com

FIG. 6: REGISTERED MEDIA DATABASE TABLE

	640	645	650	655	660	665	670
	Media ID (M_1)	Registrant	Agency	Media Type	ID Tag (C_2)	Start Date	End Date
605	123456	MSNBC	NBC	MPEG-2	1110...1101	2/1/01	3/1/01
610	123457	Starwave	Starwave	Java Applet	1010...1011	2/14/01	2/28/01
615	123458	AT&T Universal Card	McCann-Erickson	PNG File	1111...0101	7/7/01	7/31/01
620	144231	IBM	Ogilvy & Mather	Acrobat File	0001...1000	12/15/01	12/31/01

Encryption Keys Database Table

700

	740	745	750	755
	Key Pair ID	Key Pair Owner	Public Key	Private Key
705	K1001	RDCA50101	1011...1001	0101...1101
710	K1002	RDCA50102	0001...1101	1111...0010
715	K1003	MRC0001	1010...1100	1011...0001
720	K10044	RDCA50159	1011...1101	1100...0110

FIG. 7

FIG. 8: LOG ENTRY DATABASE TABLE

	830	835	840	842	845	850	855	860
	Entry ID	RDC Agent ID	Media Handler ID	Media Handler Host ID	Registered Media ID	Panel Member IDs	Date	Time
805	123456	RDCA73211	MH73211	MHH2112	123456	41023,21121	07/07/2001	14:02:00
810	123457	RDCA74123	MH12111	MHH4123	0	24101	07/07/2001	14:02:01
815	123458	RDCA71212	MH17312	MHH1675	0	41511	07/07/2001	14:02:01
820	144231	RDCA41411	MH15111	MHH5121	312117	16211	10/30/2001	7:12:15

	865		870		875	
	Metadata		Contextual Information		Presentation Information	
	Program	Media Type	URL	Source	Language	Format
805	none	HTML Page	www.cnn.com/finance/	12.31.14.12	English	B/W
810	none	HTML Page	www.news.com	233.11.21.11	English	B/W
815	Seinfeld	HDTV	none	CBS-HDTV	Spanish	HDTV
820	none	MPEG-2	www.starwars.com	12.41.22.121	English	PIP

	880			
	User Interactions			
	Zoom	Rotate	Size	User Input
805	no	no	large	none
810	yes	no	medium	none
815	no	no	full screen	none
820	no	no	letterbox	none

Local Panel Member
Database Table

900

940 945

	Panel Member ID Number	Panel Member Tracking Semaphore
905	12312	In Scope
910	32311	Out of Scope
915	12322	Out of Scope

FIG. 9

Local Encryption Keys
Database Table

1000

	1040	1045	1050
	Local Key ID	Local Pair ID	Key
1005	K1	K102212	0101...1110
1010	K2	K102322	1100...0011
1015	K3	K104332	0111...0000
1020	K4	K103221	1100...1000

FIG. 10

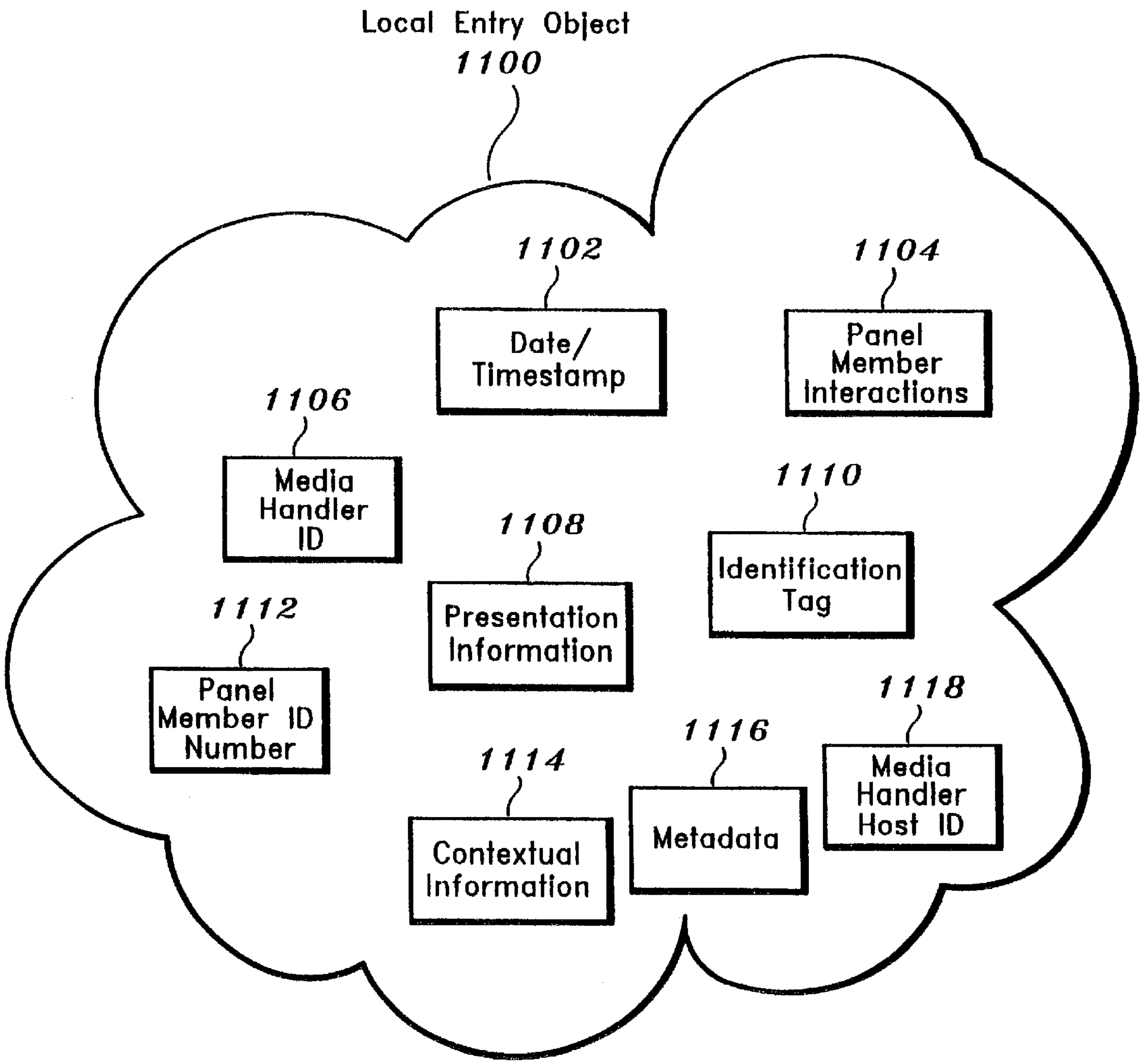

Local Entry Object
1100
1102
Date/ Timestamp
1104
Panel Member Interactions
1106
Media Handler ID
1108
Presentation Information
1110
Identification Tag
1112
Panel Member ID Number
1114
Contextual Information
1116
Metadata
1118
Media Handler Host ID

FIG. 11

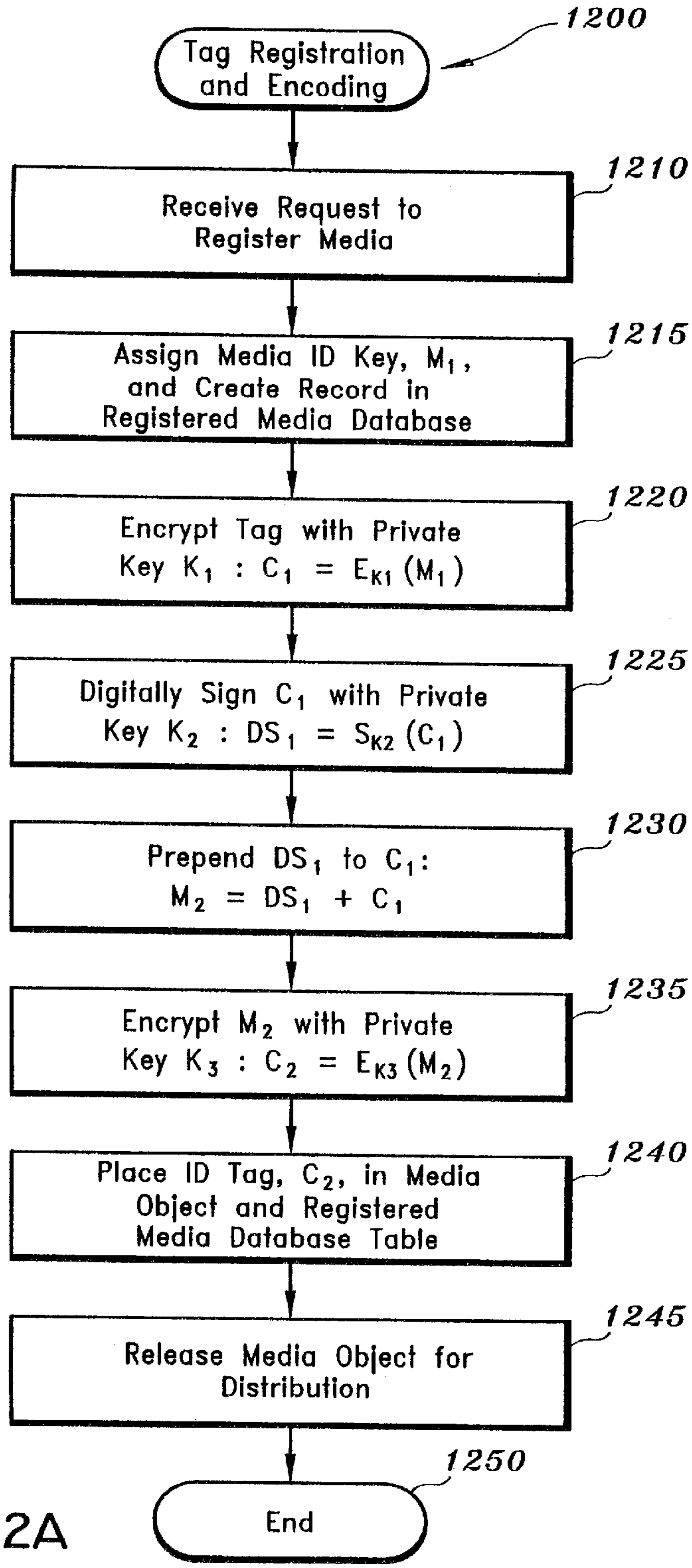

1200
Tag Registration and Encoding
1210
Receive Request to Register Media
1215
Assign Media ID Key, M_1, and Create Record in Registered Media Database
1220
Encrypt Tag with Private Key K_1 : $C_1 = E_{K1}(M_1)$
1225
Digitally Sign C_1 with Private Key K_2 : $DS_1 = S_{K2}(C_1)$
1230
Prepend DS_1 to C_1: $M_2 = DS_1 + C_1$
1235
Encrypt M_2 with Private Key K_3 : $C_2 = E_{K3}(M_2)$
1240
Place ID Tag, C_2, in Media Object and Registered Media Database Table
1245
Release Media Object for Distribution
1250
End

FIG. 12A

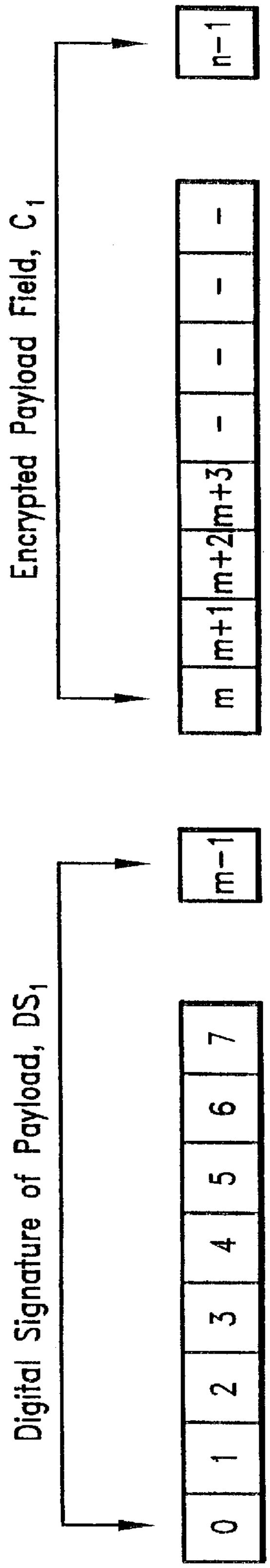


FIG. 12B

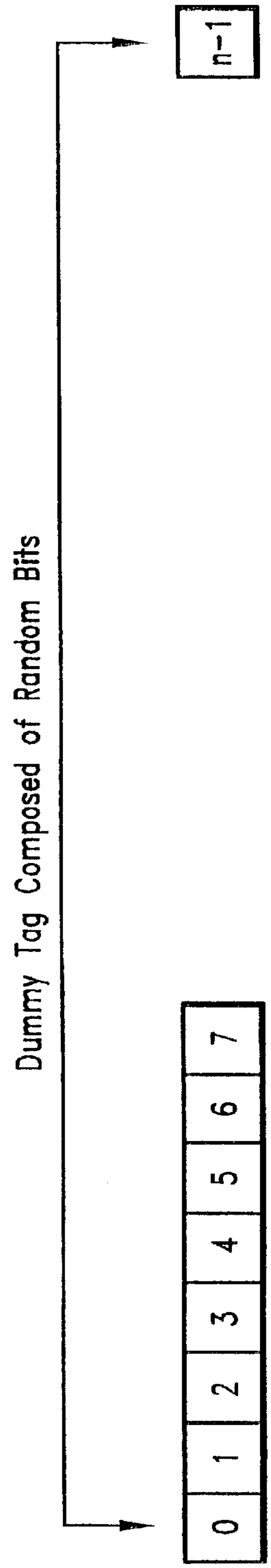


FIG. 12C

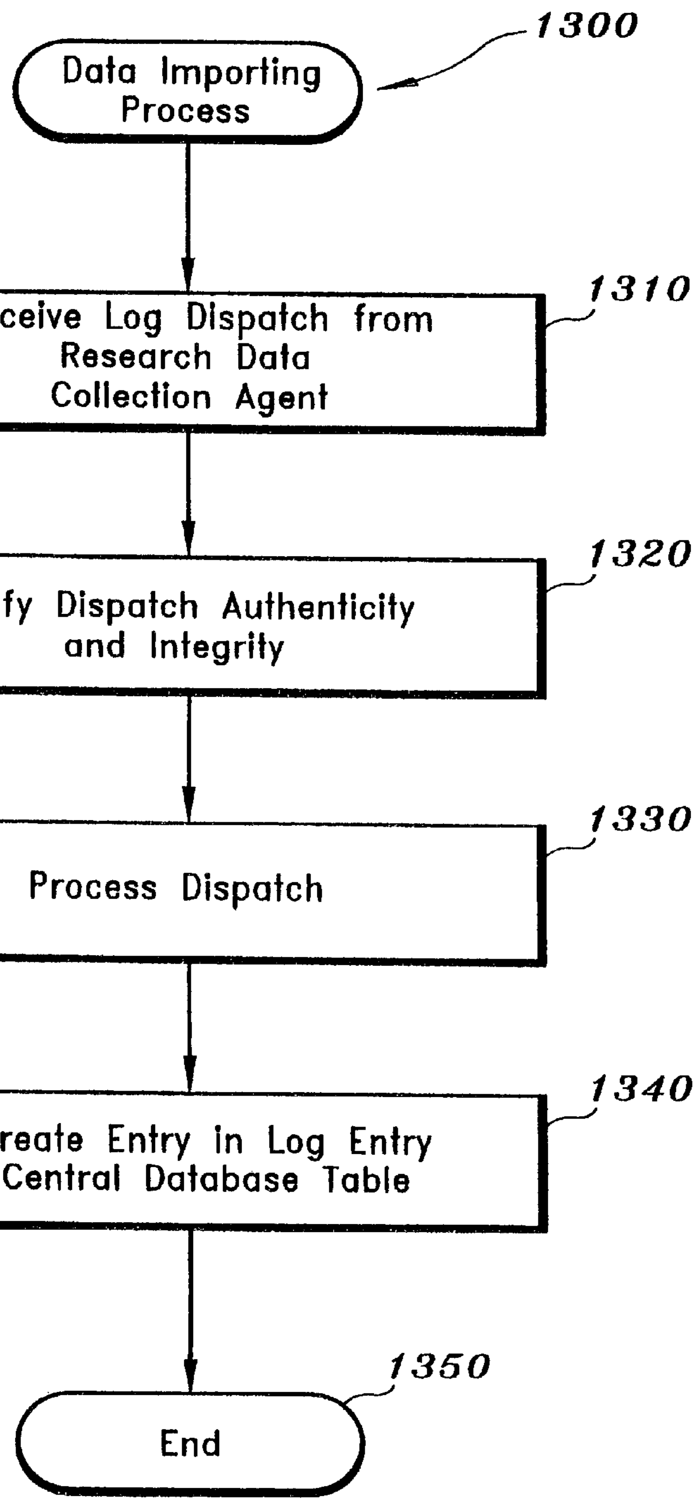

1300
Data Importing Process
1310
Receive Log Dispatch from Research Data Collection Agent
1320
Verify Dispatch Authenticity and Integrity
1330
Process Dispatch
1340
Create Entry In Log Entry Central Database Table
1350
End

FIG. 13

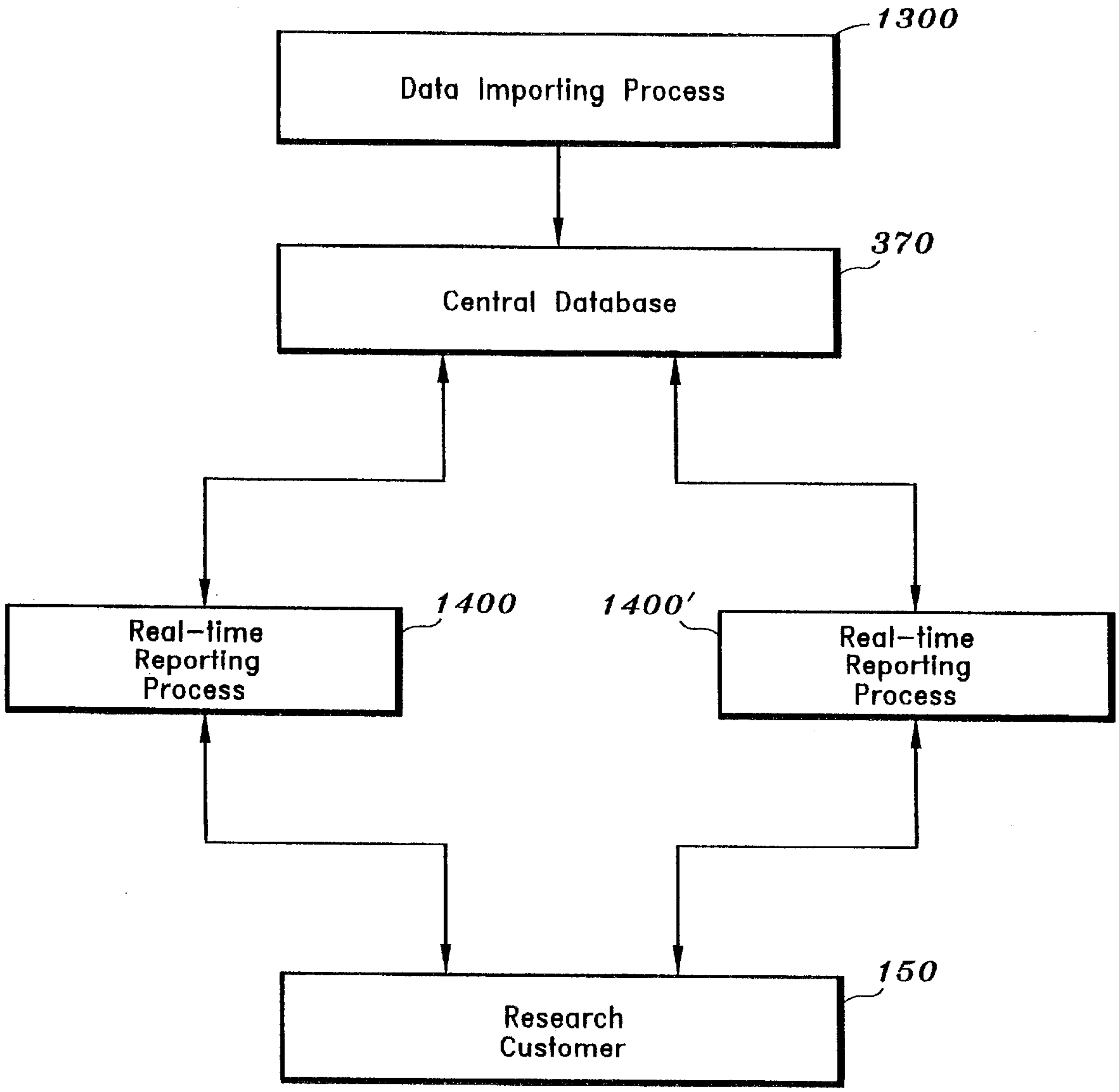

1300
Data Importing Process
370
Central Database
1400
1400'
Real-time Reporting Process
Real-time Reporting Process
150
Research Customer

FIG. 14

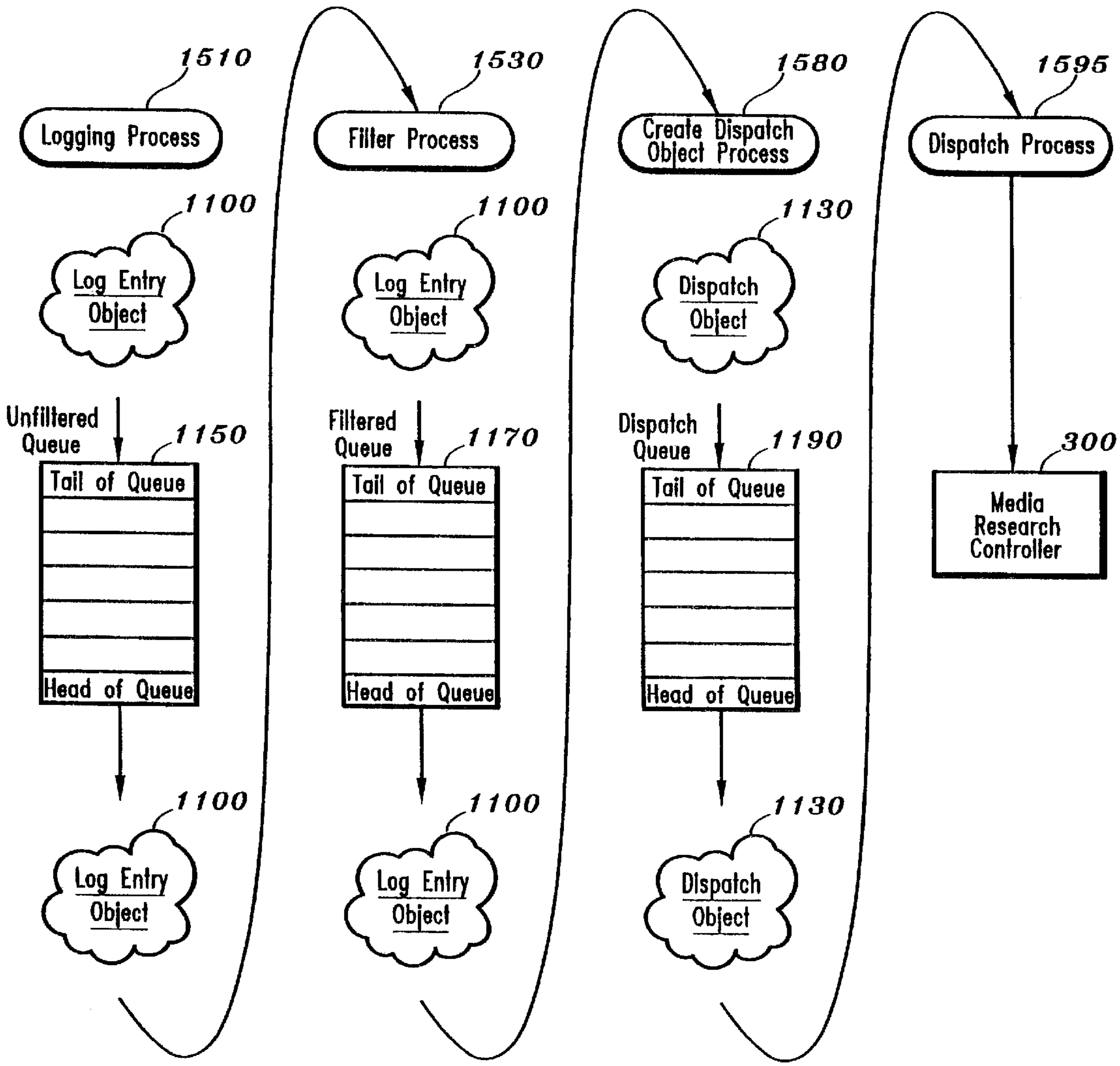

1510
Logging Process
1100
Log Entry Object
Unfiltered Queue
1150
Tail of Queue
Head of Queue
1100
Log Entry Object
1530
Filter Process
1100
Log Entry Object
Filtered Queue
1170
Tail of Queue
Head of Queue
1100
Log Entry Object
1580
Create Dispatch Object Process
1130
Dispatch Object
Dispatch Queue
1190
Tail of Queue
Head of Queue
1130
Dispatch Object
1595
Dispatch Process
300
Media Research Controller

FIG. 15A

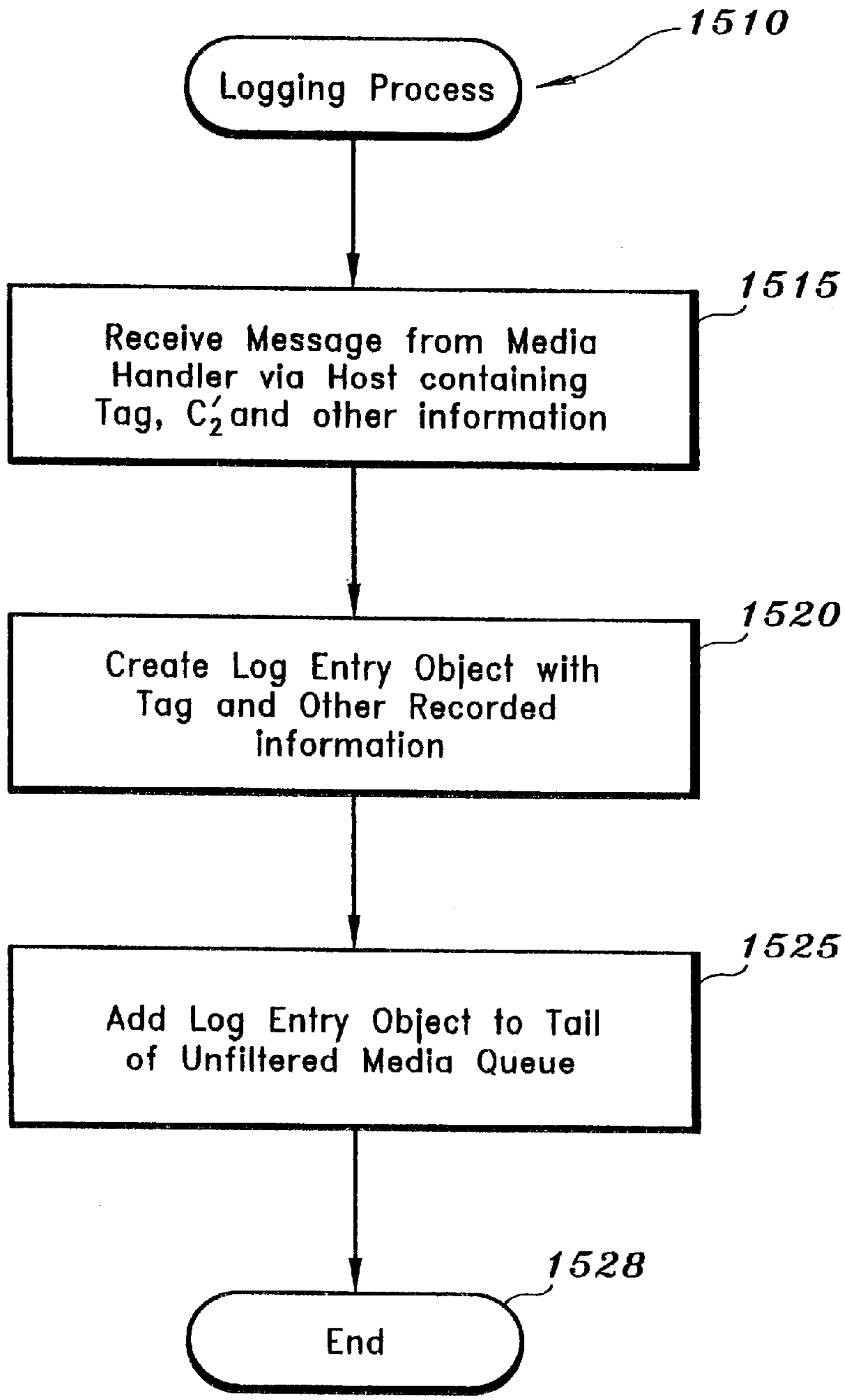
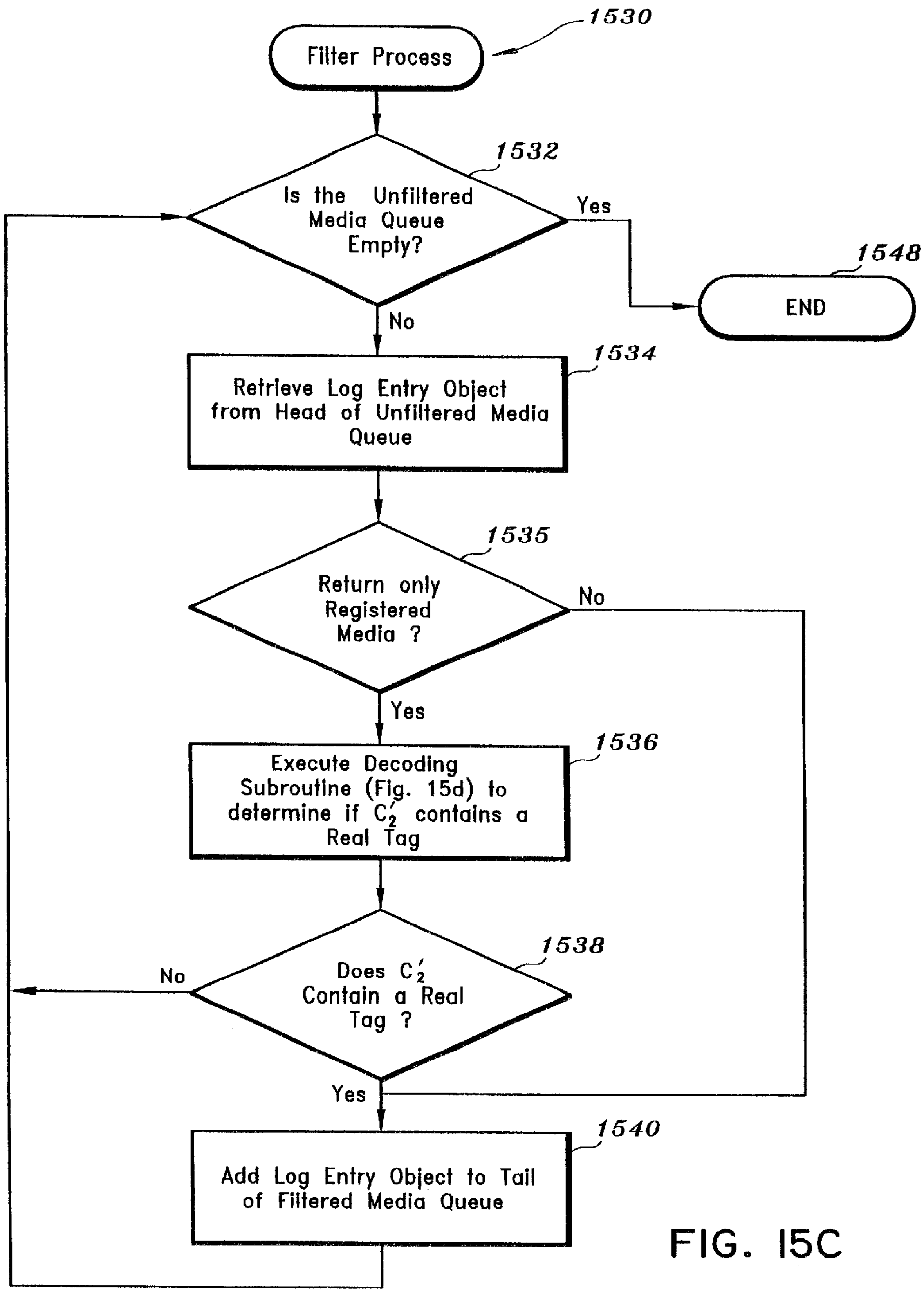
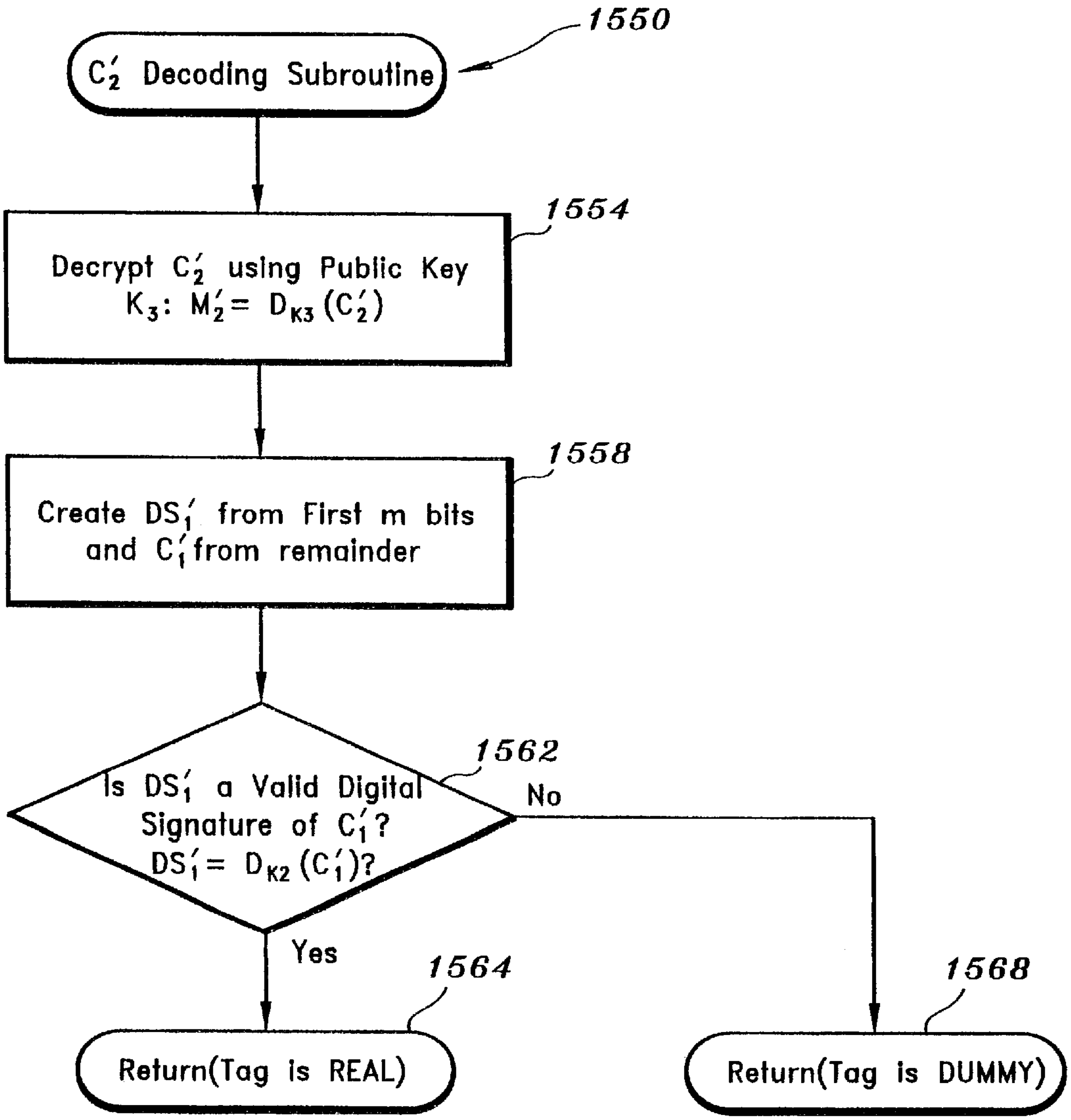

1510
Logging Process
1515
Receive Message from Media Handler via Host containing Tag, C_2' and other information
1520
Create Log Entry Object with Tag and Other Recorded information
1525
Add Log Entry Object to Tail of Unfiltered Media Queue
1528
End

FIG. 15B



1530
Filter Process
1532
Is the Unfiltered Media Queue Empty?
Yes
1548
END
No
1534
Retrieve Log Entry Object from Head of Unfiltered Media Queue
1535
Return only Registered Media ?
No
Yes
1536
Execute Decoding Subroutine (Fig. 15d) to determine if C2' contains a Real Tag
1538
Does C2' Contain a Real Tag ?
No
Yes
1540
Add Log Entry Object to Tail of Filtered Media Queue

FIG. 15C



1550
C'2 Decoding Subroutine
1554
Decrypt C'2 using Public Key K3: M'2 = DK3 (C'2)
1558
Create DS'1 from First m bits and C'1 from remainder
1562
Is DS'1 a Valid Digital Signature of C'1? DS'1 = DK2 (C'1)?
No
Yes
1564
Return(Tag is REAL)
1568
Return(Tag is DUMMY)

FIG. 15D

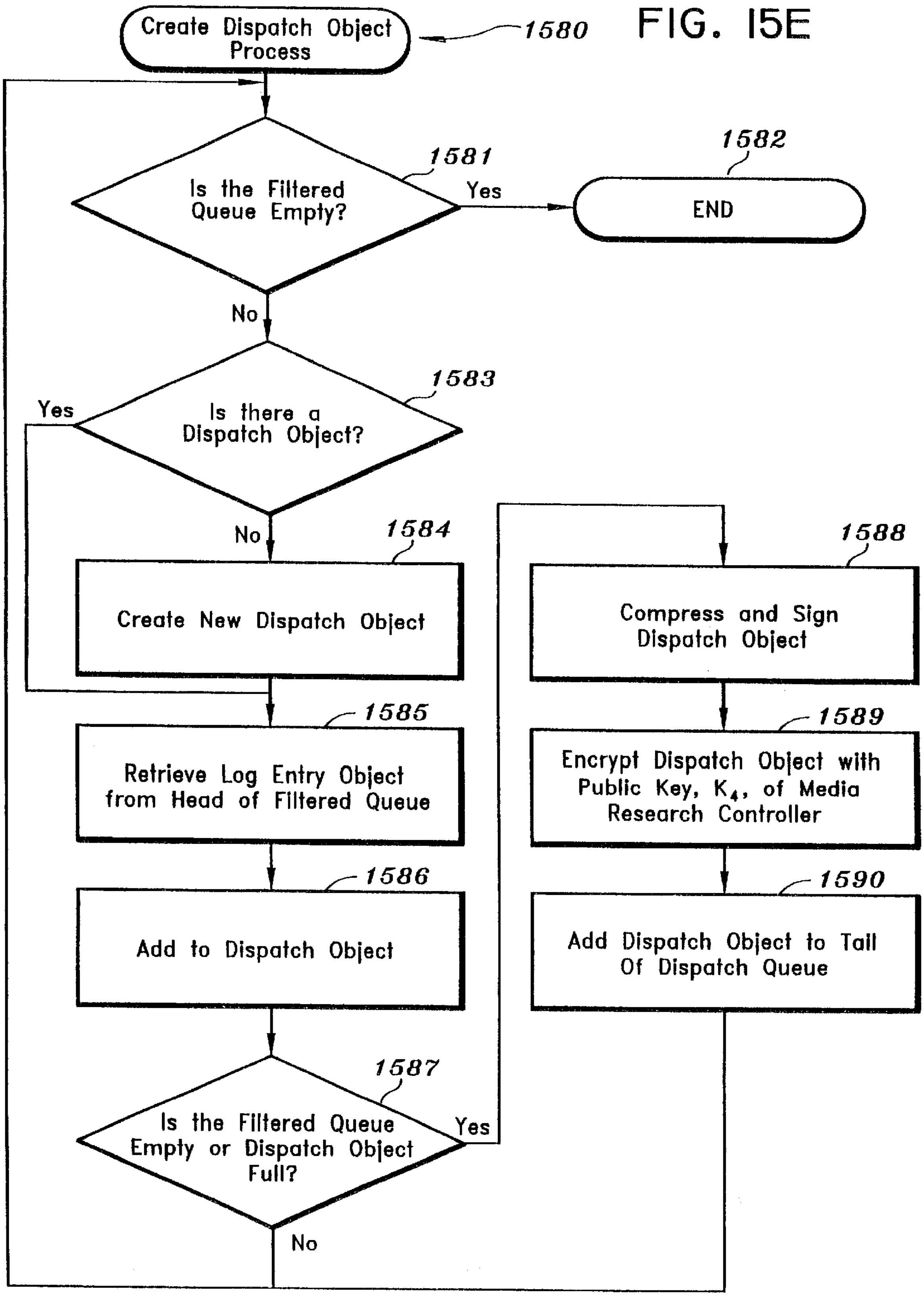

Create Dispatch Object Process
1580
1581
Is the Filtered Queue Empty?
Yes
1582
END
No
1583
Is there a Dispatch Object?
Yes
No
1584
Create New Dispatch Object
1585
Retrieve Log Entry Object from Head of Filtered Queue
1586
Add to Dispatch Object
1587
Is the Filtered Queue Empty or Dispatch Object Full?
Yes
No
1588
Compress and Sign Dispatch Object
1589
Encrypt Dispatch Object with Public Key, K_4, of Media Research Controller
1590
Add Dispatch Object to Tail Of Dispatch Queue

FIG. 15E

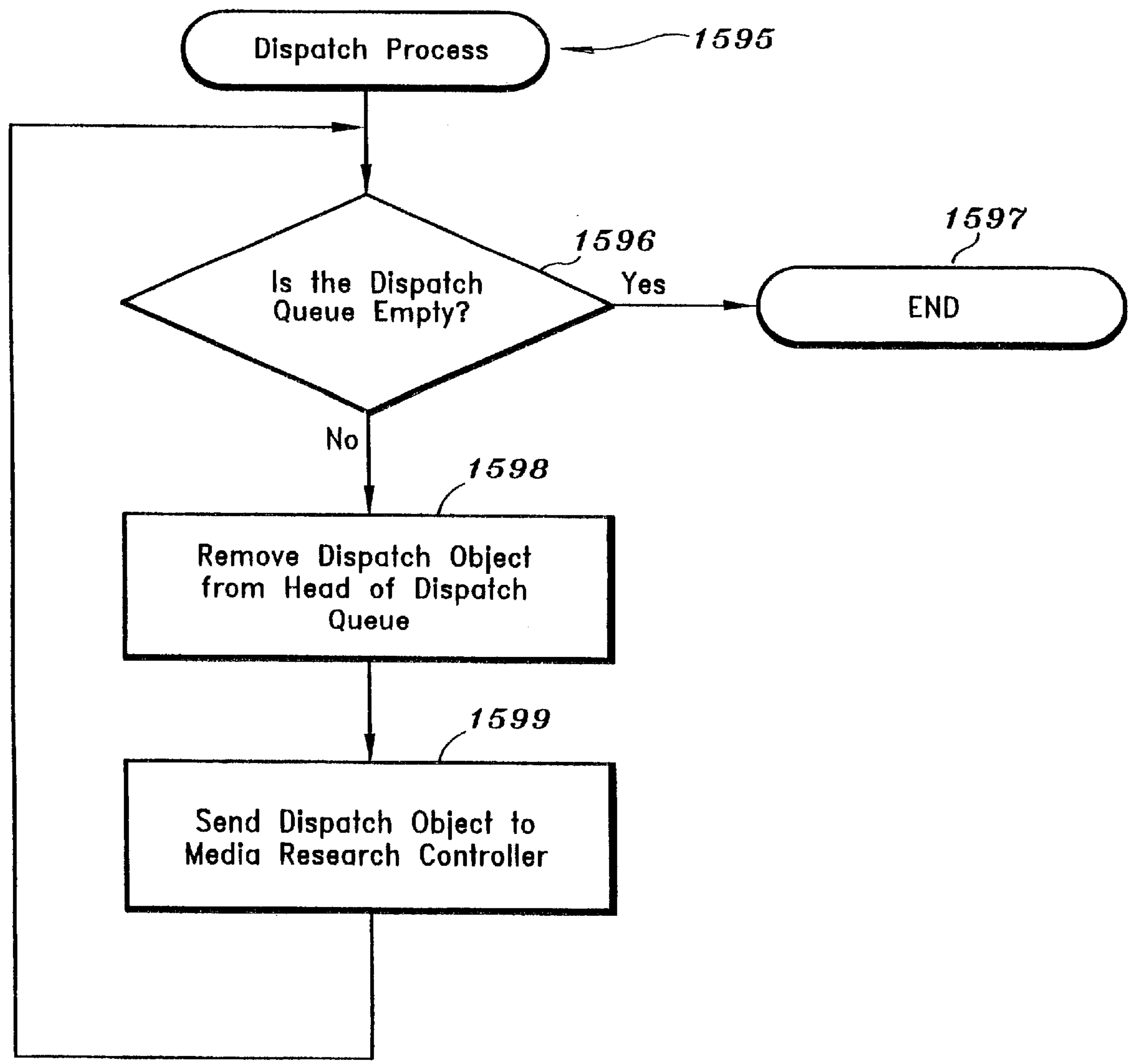

Dispatch Process
1595
Is the Dispatch Queue Empty?
1596
Yes
1597
END
No
1598
Remove Dispatch Object from Head of Dispatch Queue
1599
Send Dispatch Object to Media Research Controller

FIG. 15F

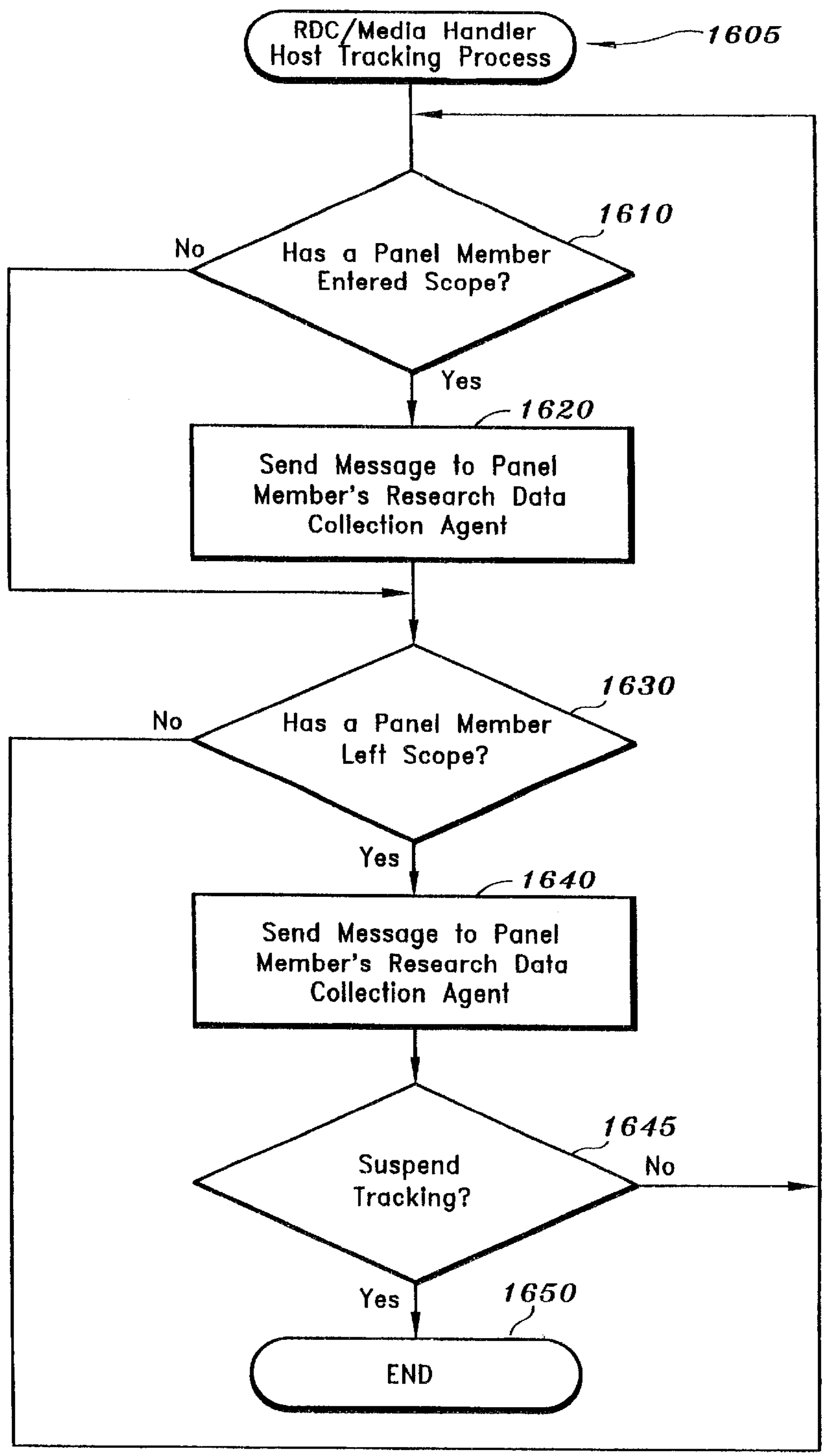

RDC/Media Handler
Host Tracking Process
1605
1610
Has a Panel Member
Entered Scope?
No
Yes
1620
Send Message to Panel
Member's Research Data
Collection Agent
1630
Has a Panel Member
Left Scope?
No
Yes
1640
Send Message to Panel
Member's Research Data
Collection Agent
1645
Suspend
Tracking?
No
Yes
1650
END

FIG. 16

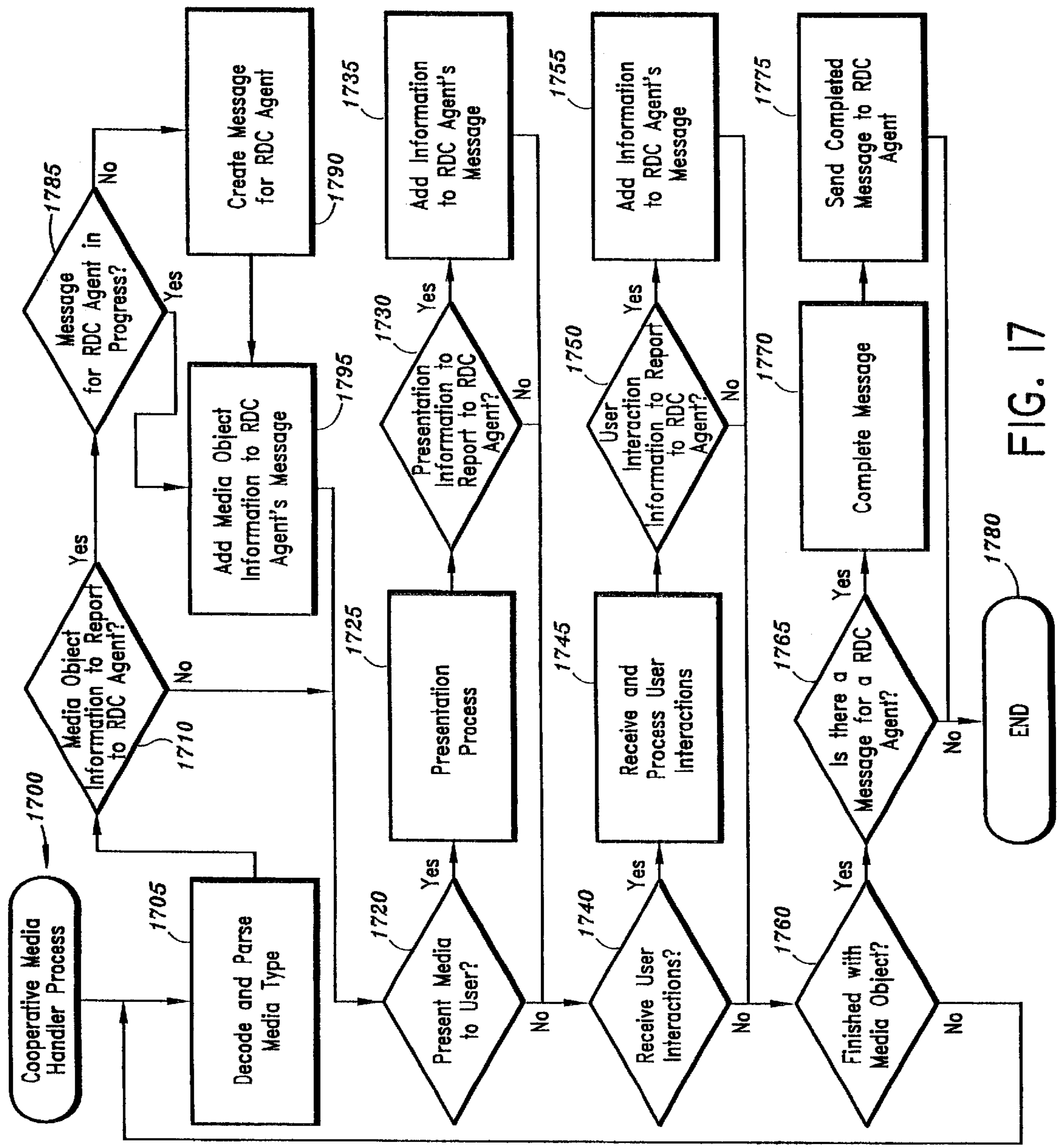

1700
Cooperative Media Handler Process
1705
Decode and Parse Media Type
1710
Media Object Information to Report to RDC Agent?
Yes
No
1785
Message for RDC Agent in Progress?
Yes
No
1790
Create Message for RDC Agent
1795
Add Media Object Information to RDC Agent's Message
1720
Present Media to User?
Yes
No
1725
Presentation Process
1730
Presentation Information to Report to RDC Agent?
Yes
No
1735
Add Information to RDC Agent's Message
1740
Receive User Interactions?
Yes
No
1745
Receive and Process User Interactions
1750
User Interaction Information to Report to RDC Agent?
Yes
No
1755
Add Information to RDC Agent's Message
1760
Finished with Media Object?
Yes
No
1765
Is there a Message for a RDC Agent?
Yes
No
1770
Complete Message
1775
Send Completed Message to RDC Agent
1780
END

FIG. 17

COOPERATIVE SYSTEM FOR MEASURING ELECTRONIC MEDIA

FIELD OF THE INVENTION

The present invention relates generally to a system for measuring a population's exposure to and interactions with electronic media (hereinafter, "electronic media measurement systems"), and more particularly, to a cooperative electronic media measurement system using media handlers to extract information from, or otherwise obtain information about, presented media objects, including identification tags, if present, for collection by software agents on behalf of a centralized media research facility.

BACKGROUND OF THE INVENTION

The success of any advertising campaign depends on the accurate placement of advertisements within media, and the verification that specific advertising messages were presented in accord with a predefined media plan. Generally, an advertising campaign is targeted for one or more segments of a population, with media planners determining the best media a vehicles to reach the target audience. In this manner, the advertiser seeks to find the most efficient media to minimize the cost to deliver a desired audience.

Thus, prior to executing a given advertising campaign, media planners use syndicated research, such as Nielsen ratings, to determine the best media vehicles to reach a target audience. In addition, media planners utilize other information sources to research and compare the costs associated with reaching an audience through each available media vehicle. During a given advertising campaign, it is helpful to measure the target audience's exposure to the advertising messages, since media planners might make corrections in order to optimize the execution of the media plan. Likewise, after a given advertising campaign, media planners often analyze the execution of the campaign to confirm that the advertising messages reached the targeted audience to determine the accuracy of the campaign's messages in reaching the targeted audience.

As audiences have fragmented, due to the increasing number of available channels and online options, it has become increasingly challenging for media planners to determine which media vehicles provide the best avenue to a given audience. The Internet, in particular, provides advertisers with many media options and is becoming ubiquitously available in an expanding variety of personal electronic devices, far beyond its initial limited availability to users via computer terminals and desktop computers. As with other media, advertising has become an important part of Internet revenue models. Much of the Internet's value to the advertising community is due to its enormous and evolving diversity of advertising formats, including the banner ad and Java applets, and its capability to deliver customized and relevant advertising to end users. For a more detailed discussion of advertising media, see D. Jugenheimer et al., Advertising Media Strategy and Tactics (W.C.B. Brown & Benchmark, 1992), incorporated by reference herein.

Thus, the Internet provides an efficient mechanism for matching the advertising message to the appropriate segment of the audience. Such diverse advertising formats, however, present challenges for measuring a population's exposure to and interactions with such advertisements. While the success of the Internet can be attributed, in large part, to its open media standards that permit the creation and delivery of content having diverse formats across many

platforms, there is currently no user-centric system capable of adequately measuring the diverse media formats across the growing variety of Internet-enabled consumer platforms, consistent with the needs of the advertising community.

Generally, a given population's exposure to and interactions with media is measured by knowing the television channels and other information sources that the members of the population select. This can be performed either as a census, where the choices of the entire population are collected, or as a sample, where a statistically valid subpopulation or panel is chosen to represent the entire population. Nielsen Media Research, for example, uses a panel of households, known as "Nielsen Families," for measuring television viewing. Such panels enable research companies to correlate demographics, such as age, gender, income and education, with choice of content.

Conventional content frequently contains, or is associated with, metadata that provides information about the content. For example, many broadcasters transmit information with conventional programming to help identify the content, for example, by program and episode. Nielsen, for example, extracts such accompanying information for measurement purposes to track the programs viewed by certain members of a panel. In addition, smart electronic program guides use such accompanying information to help individuals or their agents find content of interest.

Similarly, the World Wide Web Consortium (W3C), has endorsed the Platform for Internet Content Selection (PICS), which is an open standard for tagging information and coding content on the Internet. The PICS standard is designed to allow software to automatically filter content that individuals choose not to receive, such as violent content, according to a ratings system. The PICS standard provides parents and other individuals with the ability to select categories of content that can be automatically blocked, in a similar manner to V-chip technology, for conventional programming. While the PICS standard allows an entire web site or static pages to be rated, the PICS standard does not permit tagging content on an object level.

In addition, traditional electronic advertising, such as television and radio advertisements, have unique identification codes, or Industry Standard Commercial Identification (ISCI) codes, which are used for handling, broadcasting, storing and retrieving commercials. Under the ISCI standard, an ISCI alpha prefix and an ISCI numeric code identify each commercial. An ISCI prefix is assigned by ISCI to national and regional advertisers and advertising agencies. The ISCI code may be used in any manner, at the discretion of the prefix owner, provided the code consists of four letters followed by four numbers. Although ISCI codes are not presently encoded as computer readable data with each advertisement, they might evolve to do so for Internet advertising, to better manage advertising on the Internet.

There exists both "pull" and "push" models for delivering Internet content. On traditional web sites, individuals "pull" content by browsing. These web sites can use tools to analyze the "hits" to their sites in real-time. Additionally, there exist "push" models of content delivery, such as provided by PointCast™. PointCast™ is a webcasting service that "pushes" or streams a variety of information, including editorial and advertising content, to a receiving software component, such as their proprietary screensaver, or Microsoft's Internet Explorer browser, version 4.0. Presently, each PointCast™ subscriber self-reports demographic information. Therefore, PointCast™ can provide advertisers with user-centric information about advertising

exposure. Self-monitoring, however, is contrary to advertising industry guidelines, which express a preference for measurement by a disinterested third party. In addition, the PointCast™ system is limited to measuring only electronic media distributed by PointCast™.

Even assuming that an independent auditor verified such site-centric measurements, the measurements often do not accurately reflect the activity of individuals. For example, many of the "hits" on a web site are associated with electronic agents that perform functions on the Internet on behalf of individuals. Examples of such electronic agents include web robots, issued by search engines such as those provided by Infoseek Corp. to index the contents of the Internet, and personal agents that automatically retrieve information from the Internet that matches the specified preferences of an individual. Thus, such electronic agents increase the traffic count of the respective web site, as they are not necessarily representative of an individual viewing Internet content. For example, an agent might download the entire contents of a site, while the user only views a single article. Proxy servers, on the other hand, which cache or copy Internet content to a local server or hard disk drive for subsequent access, can decrease the traffic count of a given web site. Proxy servers are used to reduce access time by storing a copy of information that was recently downloaded from a site. Thus, upon a subsequent request, the information can be delivered from the local server rather than the Internet without the knowledge of the web site traffic counter.

While conventional electronic media measurement systems, such as Nielsen Media Research's PeopleMeter™, have successfully measured traditional media, such as television and radio, such systems are not easily extendable to the Internet environment. In addition, the site-centric measurement approaches discussed above have proven unsatisfactory. In order to accurately measure a population's exposure to and interactions with such electronic media, a user-centric measurement approach is needed which is based on a panel chosen to be statistically representative of the total population of interest. Current user-centric Internet measurement systems, however, such as the NPD Group's PC Meter™, are based on interception and interpretation of electronic media presented to members of a panel. Such interception techniques, however, rely on observing calls by software applications to the operating system and require privileged access into operating system internals. Furthermore, PC Meter™ is currently limited to household users of the Windows™ operating system, which may not be statistically representative of the total population of interest. For a more detailed discussion of the PC Meter™ system, see PCT Published Application Number WO 96/41495.

It is believed that observing operating system internals will become increasingly challenging, if not impossible, with the trend towards more secure operating systems and communication security. Windows NT™ from Microsoft™, for example, implements a concentric ring structure of ascending privilege with an outermost ring of lowest privilege and an innermost ring of highest privilege, from which applications are excluded, based on the processor ring architecture specified by Intel Corporation. As security services become more available to Internet applications, both for computer-to-computer communications and application-to-application communications, much of this internal traffic will be encrypted. In addition, such operating system monitoring techniques will be challenging to implement within the many proprietary implementations of Internet-enabled devices, such as WebTV™. Even assuming that such user-centric measurement systems are successful in obtaining access to these communications, it is very challenging to understand what the intercepted messages mean.

A recent industry article indicates that a new company, Relevant Knowledge Inc., of Atlanta, Ga., has developed a real-time approach to compete with the PC Meter™ system.

Although Relevant Knowledge Inc. did not comment publicly for the article, it does not appear that Relevant Knowledge Inc. is using a cooperative approach. Rather, it appears that Relevant Knowledge Inc. is monitoring information, using interception and interpretation, and leveraging the communication capabilities of the Internet to distribute their monitoring software to their panel members and to collect data in real-time.

As apparent from the above-described deficiencies with conventional electronic media measurement systems, a need exists for a universal system for measuring electronic media having diverse formats, including television, radio, Internet, and online services, across a plurality of platforms. A further need exists for a cooperating system that extends the open media standards of the Internet to measure a population's exposure to and interactions with such electronic media. Yet another need exists for a system to measure traditional television, radio, cable television, digital satellite programming and advertising delivered to households that use Internet-enabled computers and appliances for viewing, listening and interacting with such content.

SUMMARY OF THE INVENTION

Generally, according to one aspect of the invention, media information presented to a panel member by means of a panel member-computing device is measured by a media research controller for subsequent reporting to one or more research customers. The panel member-computing device may receive the media information by means of a network connection, or from one or more local sources, such as prerecorded media obtained from a CD-ROM or DVD player, or may generate the media objects in real-time, or a combination thereof. The media research controller registers advertisements and other media for subsequent measurement and provides a unique identification tag that may be added to, or associated with, the existing media object for identification purposes. In addition, the present invention extracts information from, or otherwise obtains information about, presented media objects, including metadata or other information associated with a given media object, for later collection by the media research controller even when the media object has not been previously registered and tagged by the media research controller. Thus, a panel member's exposure to and interactions with all electronic media is measured, regardless of whether the media has been previously registered or tagged for identification purposes. The panel members are preferably chosen for their demographics and have agreed to participate in a research panel to have their electronic media measured.

The media research controller preferably assigns one or more software agents, hereinafter referred to as research data collection (RDC) agents, to measure each panel member's exposure to and interactions with electronic media. Thus, each research data collection agent serves as an intermediary between the local environment of a panel member and the central media research controller. In one embodiment, a research data collection agent is associated with each computing device utilized by a given panel member. Thus, a single panel member might be assigned multiple research data collection agents, if required, to measure the panel

member's use of electronic media across multiple devices. Furthermore, a single research data collection agent may serve a plurality of panel members utilizing the same computing device.

According to a further aspect of the invention, cooperative media handlers are utilized by the panel member-computing device to present media to a panel member and to extract information from, or otherwise obtain information about, the media objects, including identification tags, if present, for collection by the research data collection agents. As used herein, the term cooperating system means a system that relies on the media handler software which presents the media to cooperate by gathering and developing information about media activities of end users, and transmitting such activity information to the media research controller, either directly or indirectly via the research data collection agents, in effect acting as agents of the media research controller, as opposed to conventional approaches of intercepting and interpreting the media activities of end users.

As used herein, the term media handler includes persistent software components which extend the capabilities of a software application or operating system to present media objects of a particular media type to an individual and autonomous software components, such as Java applets, which may only temporarily extend the capabilities of the host to present media. In addition, the term media handler includes software applications that generate media experiences in real-time, such as video games, and resident software components, such as the PointCast™ agent, which present media to end users. In addition, the term media handler includes those portions of an Internet browser, also called "viewers" and "plug-ins", that are capable and responsible for decoding specific media types, such as JPEG images, and using the resources of their host to present the media to the end user. The media handlers may be mobile, moving from one host computer to another, or stable, anchored to one host.

Thus, in addition to their primary function of presenting media, the cooperative media handlers also serve as software agents for the research data collection agents, by gathering and deriving relevant information about the media presentation on behalf of the research data collection agents and then sending this information to the research data collection agents. The media handlers are in the best position to provide information about the media objects presented to the panel members, since the media handler can decode the particular media type, and determine what is presented to the individual, when it is presented and how the individual interacts with the object. In this manner, the media handler can report on a panel member's exposure to and interactions with a media object, such as zooming in on a particular feature of a media object or rotating the object, and the source of the control signals, such as a specific individual or process. In the case of stable, installed media handlers, such as video games or screensaver clients; or in the case of mobile, transient media handlers, such as a Java applet advertisement, they become cooperative through the implementation of an application programming interface (API), and communicate to the research data collection agents via their host. In all of these instances, the media handler's host might contribute contextual information, such as the web site of origin, to the media handler along with the media object.

The hosts of the research data collection agent and the cooperative media handlers preferably provide them with necessary computational resources, such as processor cycles, memory and communication. In the illustrative embodiment, an Internet browser software product, such as Netscape Navigator™ or Microsoft Internet Explorer™, resident on the panel member-computing device, serves as the host for both the research data collection agent and the cooperative media handler. In alternate embodiments, the host for one or both of the research data collection agent and the cooperative media handlers may be embodied as an operating system or a virtual machine, such as the Java virtual machine. The research data collection agents and the cooperative media handlers (the hosted processes) preferably use an application programming interface (API) to define the function calls which the hosted processes and their hosts use to communicate and share resources and services. In this manner, different companies can develop interoperable research data collection agents, cooperative media handlers and hosts.

When electronic media is received by a cooperative media handler, the media handler automatically extracts information from, or otherwise obtains information about, the media, including an identification tag, if present, for transmission to a research data collection agent. In addition to the extracted identification tag, if present, the cooperative media handler preferably transmits any content metadata included in or associated with the media object, an indication of the media handler's identification number and any contextual information which has been made available to the media handler by its host, including program, episode, version, and source information for television and radio programming, or a source computer's domain name or IP address for a web site, and content rating information, such as PICS, if available.

A research data collection agent preferably commences tracking of a panel member, and begins collecting such transmissions from the cooperative media handlers, when a panel member enters the scope of the research data collection agent and has been identified and authenticated, for example, following a log on procedure. Similarly, the research data collection agent suspends tracking of a panel member when the person leaves the scope of the remote media research agent, such as following a log off procedure. The research data collection agent (i) creates log entry objects from transmissions received from the cooperative media handlers and places the log entry objects into an unfiltered media queue, (ii) confirms the integrity of the messages and filters out unnecessary log entry objects from the unfiltered media queue to create a filtered media queue, (iii) creates dispatch objects using objects from the filtered media queue and places created dispatch objects into a dispatch queue, and (iv) transmits dispatch objects from the dispatch queue to the media research controller, when resources are available.

Identification tags are preferably placed at periodic intervals throughout the duration of continuous media, such as audio and video, or on an associated data channel. Since identification tags might be utilized by hostile software to automatically remove advertising media objects, the identification tags are preferably placed in both the advertising, as well as the associated advertising-supported media objects to discourage such automatic removal. In one preferred embodiment, "real" identification tags are placed in media that is to be measured (and a fraction of media that is not to be measured), and "dummy" identification tags are placed in other content. The research data collection agents can preferably distinguish real identification tags from dummy identification tags, and, if desired for efficiency purposes, can only return measurements about registered media objects containing real identification tags to the media research controller.

A more complete understanding of the present invention, as well as further features and advantages of the present invention, will be obtained by reference to the following detailed description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic block diagram illustrating a suitable communications network for interconnecting a panel member with one or more content providers and a media research controller of an electronic media measurement system;

FIG. **2** illustrates the communications and cooperative relationship between the various entities shown in FIGS. **1**, **3** and **4**;

FIG. **3** is a schematic block diagram of the media research controller of FIG. **1**;

FIG. **4** is a schematic block diagram of a panel member-computing device of FIG. **1**;

FIG. **5** illustrates a sample table from the panel member database table of FIG. **2**;

FIG. **6** illustrates a sample table from the registered media database table of FIG. **2**;

FIG. **7** illustrates a sample table from the encryption keys database table of FIG. **2**;

FIG. **8** illustrates a sample table from the log entry database table of FIG. **2**;

FIG. **9** illustrates a sample table from the local panel member database table of FIG. **3**;

FIG. **10** illustrates a sample table from the local encryption keys database table of FIG. **3**;

FIG. **11** illustrates a sample log entry object from the media queues of FIG. **3**;

FIG. **12***a* is a flow chart describing an exemplary tag registration and encoding process as implemented by the media research controller of FIG. **3**;

FIGS. **12***b* and **12***c* illustrate an exemplary identification tag format definition for a real identification tag and a dummy identification tag, respectively;

FIG. **13** is a flow chart describing a data importing process as implemented by the media research controller of FIG. **3**;

FIG. **14** is a flow chart illustrating a reporting process as implemented by the media research controller of FIG. **3**;

FIG. **15***a* provides an overview of the processes shown in FIGS. **15***b* through **15***f* on the media queues of FIG. **4**;

FIG. **15***b* is a flow chart describing a logging process as implemented by the research data collection agent of FIG. **4**;

FIG. **15***c* is a flow chart describing a filter process as implemented by the research data collection agent of FIG. **4**;

FIG. **15***d* is a flow chart describing a tag decoding subroutine as implemented by the research data collection agent of FIG. **4**;

FIG. **15***e* is a flow chart describing a create-dispatch object process as implemented by the research data collection agent of FIG. **4**;

FIG. **15***f* is a flow chart describing a dispatch process as implemented by the research data collection agent of FIG. **4**;

FIG. **16** is a flow chart describing a suitable host tracking process as implemented by the panel member-computing device of FIG. **4**; and

FIG. **17** is a flow chart describing a cooperative media handler process as implemented by the panel member-computing device of FIG. **4**.

DETAILED DESCRIPTION

FIG. **1** shows an illustrative network environment for transferring media information, such as video, audio and data, from one or more content providers **110**, **120**, to a panel member **205** operating a panel member-computing device **400**, discussed further below in conjunction with FIG. **4**, over one or more external networks, such as network **130**. In an alternative or supplemental embodiment, discussed further below, the panel member-computing device **400** may be configured to receive media information from one or more local sources, such as prerecorded media obtained from a CD-ROM or DVD player, or to generate media objects in real-time, for example, by means of a video game generating an advertising image with the name of the panel member for placement on a wall inside a virtual world, or a combination thereof. According to a feature of the present invention, the media information presented to the panel member by means of the panel member-computing device **400** is measured by a media research controller **300**, discussed further below in conjunction with FIG. **3**, for subsequent reporting to one or more research customers **150**. It is noted that the reports may be generated by the media research controller **300** in real time, or historically, or both.

The external networks **130** shown in FIG. **1** include the Internet, the Public Switched Telephone Network ("PSTN") and networks for the delivery of radio and television programming, such as the Digital Satellite Service ("DSS™"), cable television ("CATV") and other over-the-air transmission networks for broadcast television, radio and satellite communications. The PSTN, as used herein, includes the combination of local and long distance wire or wireless facilities and switches, as well as cellular network systems. The Internet, as used herein, includes the World Wide Web (the "Web") and other systems for storing and retrieving information using the Internet.

According to a feature of the present invention, the media research controller **300** registers advertisements and other media for subsequent measurement and provides a unique identification tag that may be added to, or associated with, the existing media object for identification purposes. In addition, the present invention extracts information from, or otherwise obtains information about, presented media objects, including metadata or other information associated with a given media object, for later collection by the media research controller **300** even when the media object has not been previously registered and tagged by the media research controller **300**. In this manner, the present invention measures a panel member's exposure to and interactions with all electronic media, regardless of whether the media has been previously registered or tagged for identification purposes. The panel members are preferably chosen for their demographics and have agreed to participate in a research panel to have their electronic media measured. The panel is preferably constructed so that it is representative of and projectable to the entire population. It is noted that if a census is desired, as opposed to a panel, the panel simply consists of the entire population of interest.

Entity Relationships and Interfaces

As shown conceptually in FIG. **2**, the present invention preferably consists of a number of cooperating entities to measure electronic media presented to a panel member **205** by means of the panel member-computing device **400**, namely, a centralized media research controller **300**, a research data collection agent **1500** and a cooperative media handler **1700**. As previously indicated, the media research controller **300** measures a panel's exposure to and interactions with electronic media for subsequent reporting to one or more research customers **150**. As used herein, the term cooperating system means a system that relies on the media

handler software which presents the media to cooperate, by gathering and developing information about media activities of end users and transmitting such activity information to the media research controller, either directly or indirectly via the research data collection agents, in effect acting as agents of the media research controller, as opposed to conventional approaches of intercepting and interpreting the media activities of end users.

To this end, the media research controller **300** preferably assigns one or more software agents, referred to as research data collection agents **1500**, discussed further below in conjunction with FIG. **15**, to measure each panel member's exposure to and interactions with electronic media. Thus, each research data collection agent **1500** serves as an intermediary between the local environment of a panel member **205** and the central media research controller **300**. In one embodiment, a research data collection agent **1500** is associated with each computing device **400** utilized by a given panel member **205**. Thus, a single panel member might be assigned multiple research data collection agents, if required to measure the panel member's use of electronic media across multiple devices. Furthermore, a single research data collection agent **1500** may serve a plurality of panel members utilizing the same computing device **400**. It is not necessary for the research data collection agent **1500** to be proximal to the associated panel member or the panel member's physical environment. Since the research data collection agent **1500** is user-centric, the agent **1500** might be a component of the person's net-centric environment and be activated as a side effect of the person obtaining access to network resources, or the agent **1500** may reside on a smartcard carried by the individual.

In addition, the cooperative media handlers **1700**, discussed below in conjunction with FIG. **17**, are utilized by the panel member-computing device **400** to present media to the panel member **205** and to extract information from, or otherwise obtain information about, presented media objects, including identification tags, if present, for collection by the research data collection agents **1500**. Thus, in addition to their primary function of presenting media, the cooperative media handlers **1700** also serve as software agents for the research data collection agents **1500**, by gathering and deriving relevant information about the media presentation on behalf of the research data collection agents and then sending this information to the research data collection agents. It is noted that while some of the media handlers might be implemented as cooperative media handlers **1700**, as described herein, the present invention is not dependent upon all of the media handlers being implemented in a cooperative manner. However, the extent of research data collection agent's **1500** ability to measure a panel member's exposure to and interactions with electronic media is limited to media presented by means of a cooperative media handler **1700**.

As used herein, a software agent is a software component that has the ability and authority to act on behalf of a controlling entity, generally instantiated as a process on a host computer. Each agent's controlling entity provides the agent with resources, such as encryption keys and a digital certificate for identification, and delegates specific tasks to the agent. The software agents manage these tasks, and operate in an autonomous or semi-autonomous mode with respect to its controlling entity. The software agents may be mobile, moving from one host computer to another, or stable, anchored at one host.

The software agent's host preferably provides the software agent with necessary computational resources, such as processor cycles, memory and communication. In the illustrative embodiment, discussed further below, an Internet browser software product, such as Netscape Navigator™ or Microsoft Internet Explorer™, resident on the panel member-computing device **400**, serves as the host **1600** for the research data collection agent **1500** and the host **1600'** for the cooperative media handler **1700** and provides them with the required computational resources. In alternate embodiments, the host for one or both of the research data collection agent and the cooperative media handlers may be embodied as an operating system or a virtual machine, such as the Java virtual machine. The research data collection agent **1500** preferably communicates with the media research controller **300** by means of the host's secure communication capabilities, such as SSL or S/MIME. In addition, the research data collection agent **1500** relies on its host **1600** to pass through data sent by the cooperative media handler **1700** for collection by a research data collection agent **1500**.

The communications between the various entities are preferably sufficiently encrypted to protect the privacy of the panel members **205**, the proprietary information and competitive interests of the media research controller **300** and the validity of the collected data, as would be apparent to a person of ordinary skill. Furthermore, to protect the privacy of nonpanel members, the cooperative features of the hosts **1600**, **1600'**, as described herein, are preferably initially disabled when distributed to end-users, and are only subsequently enabled when specifically authorized by a panel member who has agreed to participate in a research panel.

In some embodiments, the research data collection agent **1500** is not proximal to the panel member(s) it tracks, or the panel member's physical environment. For example, the research data collection agent might be hosted by the central computer of an online service. In other embodiments, the research data collection agent is hosted separately from the cooperative media handlers. For example, the research data collection agent **1500** might be located in a wristwatch worn by the panel member. Thus, the host services and resources may reside locally or be accessed by means of a network connection, or a combination thereof, as would be apparent to a person of ordinary skill. It is noted that the research data collection agents **1500** and the cooperative media handlers **1700** might typically share the same host or might be hosted separately, for example, in an embodiment where the media research data collection agent **1500** associated with a panel member **205** is resident on a smartcard or wristwatch carried by an individual.

As illustrated in FIG. **2**, the present invention relies on a number of cooperative interfaces between the various entities. A media object is presented to a panel member **205** by the cooperative media handler **1700** using a conventional bi-directional user interface **210**. The cooperative media handler **1700** transmits identification tags and other information extracted from, or otherwise obtained about, media objects for collection by a research data collection agent **1500**, by means of a cooperative interface **220**. Upon receipt of an extracted identification tag or other obtained information from a media handler **1700**, the research data collection agent **1500** sends a message to the media research controller **300**, preferably over an external network **130**, containing the extracted identification tag and other obtained information.

In addition, as previously indicated, the research data collection agents **1500** and the cooperative media handlers **1700** also require interfaces to their respective hosts **1600**, **1600'**. In a preferred embodiment, the research data collection agents **1500** and the cooperative media handlers **1700**

(the hosted processes) use an application programming interface (API) to define the function calls which the hosted processes and their hosts, such as the host **1600**, use to communicate and share resources and services. In this manner, different companies can develop interoperable research data collection agents, cooperative media handlers and hosts.

Entity Functions

As previously indicated, when electronic media is received by a cooperative media handler **1700**, for presentation, the media handler **1700** automatically extracts information from, or otherwise obtains information about, presented media object, including an identification tag, if present, and other relevant information, as available, for transmission to a research data collection agent **1500**. In addition to the extracted identification tag, if present, the cooperative media handler **1700** preferably transmits any content metadata included in or associated with the media object, including program and episode information; an identification of media handler and its host; any contextual information which has been made available to the media handler **1700**, such as an indication of the media source for television and radio programming, or a source computer's domain name or IP address for a web site; any presentation information or user interaction information, and content rating information, such as PICS, if available. Each of these information types is discussed further below in conjunction with FIG. **8**.

A research data collection agent **1500** preferably commences tracking of a panel member, and begins collecting such transmissions from the cooperative media handlers **1700**, when a panel member enters the scope of the research data collection agent **1500** and has been identified and authenticated, for example, following a log on procedure. Similarly, the research data collection agent **1500** suspends tracking of a panel member **205** when the person leaves the scope of the remote media research agent **1500**, such as following a log off procedure. The research data collection agent (i) creates log entry objects from transmissions received from the cooperative media handlers and places the log entry objects into an unfiltered media queue, (ii) confirms the integrity of the messages and filters out unnecessary log entry objects from the unfiltered media queue to create a filtered media queue, (iii) creates dispatch objects using objects from the filtered media queue and places created dispatch objects into a dispatch queue, and (iv) transmits dispatch objects from the dispatch queue to the media research controller, when resources are available.

The cooperative media handlers **1700** preferably are not aware of whether or not a research data collection agent **1500** is present and measuring the content presented to a panel member, for the same reason that the identities of Nielsen families are carefully concealed from the media sources that Nielsen measures, to prevent manipulation of the content presented to the panel members. Thus, the cooperative media handlers **1700** preferably transmit information extracted from, or otherwise obtained about, presented media objects, for collection by a research data collection agent **1500**, whether or not a research data collection agent **1500** is present. For efficiency purposes, however, when the same host **1600** is hosting both the research data collection agent **1500** and media handler **1700**, the host may inhibit the cooperative media handler **1700** from transmitting information extracted from or obtained about media objects when a research data collection agent **1500** is not present, is not in a tracking mode or the panel members are not in scope.

According to a feature of the present invention, the media handlers **1700** thus cooperate with the research data collection agents **1500** by gathering and deriving relevant information about the media presentation on behalf of the research data collection agents and then sending this information to the research data collection agents. The media handlers **1700** are in the best position to provide information about the media objects presented to the panel members **205**, since the media handler is responsible for decoding or generating specific media objects, they determine what is presented, how it is presented, when it is presented and how the panel member **205** interacts with the presented media. Additionally, the media handlers **1700** can extract metadata from the media object and glean contextual information about the media object from the media handler's host. Through their cooperation and assistance, the research data collection agent can gain access to information that might not be available in any other way.

Since the media research controller **300** can measure a panel's exposure to and interactions with the cooperative media handlers **1700** themselves, in addition to exposure to and interactions with the underlying media objects of interest, providers of media handlers are motivated to develop media handlers which cooperate with the software processes of the present invention, and thereby ensure that the media handlers provide the required functionality. In this manner, media handler developers can receive custom research reports to analyze the panel's exposure to and interactions with such media handlers.

Media Terminology

A media type is a means to represent media information, such as an image or a sound. For example, the PNG (Portable Network Graphics) file format is a media type for representing computer images. As used herein, a media object is an item or instance of a media type. Currently, there are hundreds of media types in use. Typically, media types are implemented as files, and increasingly as objects, and allow for some means of attaching metadata, or information about the data. In some cases, the metadata is implemented as a text field that resides in a header preceding the content data and can be extracted prior to decoding the content data. Generally, extraction of the header data is not computationally intensive, and can take place prior to or during the decoding and display or playback of the content.

Every media type must have a corresponding media handler, located at the end-user's client side to present a given media object to an individual. As used herein, the term media handler includes persistent software components which extend the capabilities of a software application or an operating system to present media objects of a particular media type to an individual and autonomous software components, such as Java applets, which may only temporarily extend the capabilities of the host to present media. In addition, the term media handler includes software applications that generate media experiences in real-time, such as video games, and resident software components, such as the PointCast™ agent, which present media to end users. In addition, the term media handler includes those portions of an Internet browser, also called "viewers" and "plug-ins", that are capable and responsible for decoding specific media types, such as JPEG images, and using the resources of their host to present the media to the end user. The media handlers may be mobile, moving from one host computer to another, or stable, anchored to one host.

Typically, an Internet browser software product has a collection of internal media handlers, such as JPEG and GIF

decoders. When a browser encounters a media object of a given media type, the browser transfers the media object to the appropriate media handler for decoding. In addition, most browsers incorporate "plug-in" architecture, which allows third parties to develop new media types and distribute corresponding media handlers as "plug-ins." For example, Netscape Navigator™ currently has over two hundred compatible plug-ins available.

It is noted that for continuous media, such as audio and video, identification tags are preferably placed at periodic intervals throughout the duration of the media or on an associated data channel. Since the identification tags might be utilized by hostile software to automatically remove advertising, the identification tags are preferably placed in both the advertising, as well as the associated advertising-supported media objects to discourage such automatic removal. In one preferred embodiment, discussed below in conjunction with FIG. **12**, real identification tags are placed in media that is to be measured (and a fraction that is not), and dummy identification tags are placed in other content. As discussed further below, in order to permit the research data collection agents **1500** to be tasked by the media research controller **300** to report only registered media, the research data collection agent **1500** can preferably distinguish real identification tags from dummy identification tags, and, if desired, return only real identification tags to the media research controller **300**.

Media Research Controller

FIG. **3** is a block diagram showing the architecture of an illustrative media research controller **300**. The media research controller **300** preferably includes certain standard hardware components, such as a central processing unit (CPU) **310**, a random access memory (RAM) **320**, a read only memory (ROM) **330**, a clock **340**, a communications port **350**, and a data storage device **360**. The CPU **310** is preferably linked to each of the other listed elements, either by means of a shared data bus, or dedicated connections, as shown in FIG. **3**.

The CPU **310** may be embodied as a single commercially available processor, such as Intel's Pentium 100 MHz P54C microprocessor, Motorola's 120 MHz PowerPC 604 microprocessor or Sun Microsystem's 166 MHz UltraSPARC-I microprocessor. Alternatively, the CPU **310** may be embodied as a number of such processors operating in parallel, on one or more distributed processing nodes. The data storage device **360** and/or ROM **330** are operable to store one or more instructions, as discussed below in conjunction with FIGS. **12** through **14**, which the CPU **310** is operable to retrieve, interpret and execute. The CPU **310** preferably includes a control unit, an arithmetic logic unit (ALU), and a CPU local memory storage device, such as, for example, an instruction cache or a plurality of registers, in a known manner. The control unit is operable to retrieve instructions from the data storage device **360** or ROM **330**. The ALU is operable to perform a plurality of operations needed to carry out instructions. The CPU local memory storage device is operable to provide high-speed storage used for storing temporary results and control information.

As discussed further below in conjunction with FIGS. **5** through **8**, the data storage device **360** includes a central database **370** for storing a panel member database table **500**, a registered media database table **600**, an encryption keys database table **700** and a log entry database table **800**. The panel member database table **500** preferably stores personal and demographic information for each member of the panel. The registered media database table **600** preferably stores information about each media object that is registered with the media research controller **300**, including the assigned tag identification number. The encryption keys database table **700** preferably stores the public key/private key pairs that are utilized in the illustrative embodiment to implement secure communications. The log entry database table **800** preferably stores information that has been extracted from or obtained about media objects presented to panel members and provided to the media research controller **300** by the remote media research agents **1500**.

In addition, as discussed further below in conjunction with FIGS. **12** through **14**, the data storage device **360** preferably includes a registration and tag encoding process **1200**, a data importing process **1300** and a reporting process **1400**. Generally, the registration and tag encoding process **1200** registers a particular media object, and then places an assigned tag identification number in the registered media object, or otherwise associates the tag identification number with the media object. The data importing process **1300** receives log dispatches from the remote media research agents **1500**, verifies the authenticity and integrity of the received messages and places confirmed entries in the log entry table **800**. The reporting process **1400** preferably generates reports in real-time or historically, to suit the needs of a particular research customer **150**.

The communications port **350** connects the media research controller **300** to the external networks **130**, thereby linking the media research controller to each remote media research agent, as shown in FIGS. **1** and **2**. The communications port **350** preferably includes multiple communication channels for simultaneously connecting the media research controller **300** to multiple research data collection agents.

Panel Member-Computing Device

FIG. **4** is a block diagram showing the architecture of an illustrative panel member-computing device **400**. The panel member-computing device **400** may be embodied as any device which presents media to individuals, including, for example, an Internet-enabled device, such as a network computer, a set-top box, a television, a telephone, pager, or personal digital assistant. The panel member-computing device **400** typically includes certain standard hardware components, such as a central processing unit (CPU) **410**, a random access memory (RAM) **420**, a read only memory (ROM) **430**, a clock **440**, a communications port **450**, and a data storage device **460**. Each of these components **410, 420, 430, 440, 450** and **460** may be identical to the corresponding components described above in conjunction with FIG. **2**. In addition, the panel member-computing device **400** may include one or more output devices **470**, such as a video display card and video monitor, a sound card and speaker, and one or more multimedia players **480**, such as a CD-ROM or DVD device.

As discussed further below in conjunction with FIGS. **9** through **11**, the data storage device **460** includes a local panel member database table **900**, a local encryption keys database table **1000** and media queues **490**. The local panel member database table **900** preferably stores an indication of whether each panel member associated with a given research data collection agent is currently within the scope of the agent. The local encryption keys database table **1000** preferably stores each of the public key values which are required by the research data collection agent **1500** to determine if a given extracted tag is a real tag or a dummy

tag and for secure communications with the media research controller **300**. The media queues **490** preferably store information that has been extracted from or obtained about media objects presented to panel members and provided to the research data collection agent by the media handlers. As discussed further below in conjunction with FIGS. **15***a* through **15***f*, the media queues **490** preferably consist of an unfiltered media queue **1150**, a filtered media queue **1170**, each containing log entry objects **1100**, and a dispatch queue **1190**, containing dispatch objects **1130**.

In addition, as discussed further below in conjunction with FIGS. **15** through **17**, the data storage device **460** preferably includes a research data collection (RDC) agent **1500**, a RDC/cooperative media handler host **1600** and one or more cooperative media handlers **1700**. The research data collection (RDC) agent **1500** preferably includes (i) a logging process **1510** to create log entry objects from transmissions received from the cooperative media handlers and places the log entry objects into an unfiltered media queue, (ii) a filtering process **1530** to confirm the integrity of the messages and filter out unnecessary log entry objects from the unfiltered media queue, using a decoding subroutine **1550** to create a filtered media queue, (iii) a create dispatch process **1580** to create dispatch objects using objects from the filtered media queue and that places created dispatch objects into a dispatch queue, and (iv) a dispatch process **1595** to transmit dispatch objects from the dispatch queue to the media research controller, when resources are available. The RDC/cooperative media handler host **1600** preferably provides resources and services **1675** to hosted processes and executes a tracking process **1605** to notify the research data collection agents **1500** when a panel member enters or exits the agent's scope. The cooperative media handlers **1700** preferably receive and decode media objects and extract information from, or otherwise obtain information about, presented media objects, including identification tags, if present, for collection by research data collection agents **1500**.

It is noted that the research data collection agent process **1500** and related database tables **900**, **1000**, **1100** have been shown as part of the panel member-computing device **400** for illustrative purposes only, and could be resident on a device physically remote from the panel member **205** in alternate embodiments, as previously indicated, such as part of the panel member's net-centric environment which is activated as a side effect of the person obtaining access to network resources, or resident or hosted within a wristwatch that the panel member wears.

The communications port **450** connects the panel member-computing device **400** to the external networks **130**, thereby linking the computing device **400** to the media research controller **300** and content providers **110**, **120**, as shown in FIGS. **1** and **2**. The communications port **450** preferably includes multiple communication channels for simultaneous connections.

Database Tables

FIG. **5** illustrates an exemplary panel member database table **500** that preferably stores personal and demographic information for each member of the panel. The panel member database table **500** maintains a plurality of records, such as records **505–520**, each associated with a different panel member. For each panel member identified by a panel member identifier in field **540**, the panel member database table **500** includes the panel member's name, sex, age, city and state in fields **545** through **565**, respectively. In addition, the panel member database table **500** includes an indication of the member's education level and income in fields **570** and **575**, the associated research data collection agent in field **580**, and the member's email address in field **585**. The panel member identifier stored in field **540** may be utilized, for example, to index the log entry table **800**, discussed below in conjunction with FIG. **8**.

FIG. **6** illustrates an exemplary registered media database table **600** which preferably stores information about each media object which is registered with the media research controller **300**, including the assigned tag identification number. The registered media database table **600** maintains a plurality of records, such as records **605–620**, each associated with a different registered media object. For each registered media object identified by a registered media identification number (M_1) in field **640**, the registered media database table **600** includes an indication of the entity which registered the object, the associated agency and the media type in fields **645** through **655**, respectively. In addition, an encrypted and digitally signed version of registered media identification number preferably serves as the identification tag, C_2, and is recorded in field **660**. Finally, the anticipated starting and ending dates for which the media object will be distributed are recorded in fields **665** and **670**.

FIG. **7** illustrates an exemplary encryption keys database table **700** that preferably stores the public key/private key pairs which are utilized by the media research controller **300** in the illustrative embodiment to implement encrypted communications with the various entities and other security features. In a preferred embodiment, the media research controller **300** generates public key/private key pairs and securely distributes the various public keys to the research data collection agents of the panel members. In some embodiments, the agents may be provided with initial public keys prior to distributing the agent. Thus, the encryption keys database table **700** maintains a plurality of records, such as records **705–720**, each associated with a different public key/private key pair. For each pair, identified by a key pair identifier in field **740**, the encryption keys database table **700** includes an indication of the key pair owner in field **745**, namely, the entity which holds the private key, such as the research data collection agent (RDCA) **1500** or the media research controller (MRC) **300**. In addition, the encryption keys database table **700** includes the corresponding public key and private key values in fields **750** and **755**, respectively.

FIG. **8** illustrates an exemplary log entry database table **800** which preferably stores information which has been extracted from or obtained about media objects presented to panel members and provided to the media research controller **300** by the research data collection agents, in a manner described further below. The log entry database table **800** maintains a plurality of records, such as records **805–820**, each associated with a different log entry. For each log entry identified by an entry identifier in field **830**, the log entry database table **800** includes an identifier of the research data collection agent **1500**, cooperative media handler **1700**, and media handler host **1600**' associated with the log entry object in fields **835**, **840** and **842**, respectively. In this manner, the research media controller **300** can generate custom reports to analyze a panel's exposure to and interactions with the media handlers **1700** and media handler hosts **1600**' themselves, in addition to the underlying media objects of interest. In addition, each logged entry includes an identifier of the particular media object and panel member associated with the entry in fields **845** and **850**, as well as date and time stamps in fields **855** and **860**. Each entry preferably also

includes any metadata, contextual information, presentation information, and user interactions that were received in the log entry object, in fields **865**, **870**, **875** and **880**, respectively.

As shown in FIG. **8**, the metadata in field **865** may include program identification information and the corresponding media type. The contextual information in field **870** may include the URL and other information indicating the source of the corresponding media object, or the context in which it was presented to the panel member. The presentation information in field **875** may include the language and format in which the media object was presented to the panel member, or other information indicating how the objected was presented to the panel member, when alternative presentations are possible. Finally, the user interactions in field **880** may specify how the panel member interacted with the object, including whether the panel member zoomed in on portions of the media object, or rotated the object, as well as the size of the media object and any user inputs.

FIG. **9** illustrates an exemplary local panel member database table **900** which preferably stores a semaphore indicating whether each panel member associated with a given research data collection agent is currently within the scope of the agent. The local panel member database table **900** maintains a plurality of records, such as records **905–915**, each associated with a different panel member. For each panel member identified by a panel member identifier in field **940**, the local panel member database table **900** contains a semaphore in field **945** indicating whether or not the panel member is in scope.

FIG. **10** illustrates an exemplary local encryption keys database table **1000** which preferably stores each of the encryption key values which are required by the research data collection agent **1500** to determine if a given extracted tag is a real tag or a dummy tag and for secure communications with the media research controller **300**. The local encryption keys database table **1000** maintains a plurality of records, such as records **1005–1020**, each associated with a different encryption key. For each public key identified by a local key identifier in field **1040**, the local encryption keys database table **1000** includes a key pair identifier in field **1045** and the key value in field **1050**.

FIG. **11** illustrates an exemplary log entry object **1100** from the media queues **490**, which preferably stores information which has been extracted from or obtained about a given media object presented to one or more panel members and provided to the research data collection agent **1500** by the cooperative media handlers **1700**. The log entry object **1100** consists of a plurality of elements, including a date/time stamp **1102**, panel member interactions **1104**, media handler identifier **1106**, presentation information **1108**, identification tag **1110**, panel member identifier **1112**, contextual information **1114**, metadata **1116** and the media handler host identifier **1118**. Each of these information types has been described above in conjunction with FIG. **8**. In addition, the log entry object **1100** can include a copy of the media object itself, if desired.

Processes

As discussed above, the media research controller **300** preferably executes a tag registration and encoding process **1200**, shown in FIG. **12***a*, to register a particular media object, and to place an assigned tag identification number in the registered media object, or on a simultaneous channel. As illustrated in FIG. **12***a*, the media research controller **300** begins the processes embodying the principles of the present invention during step **1210** upon receipt of a request to register a particular media object.

Thereafter, the media research controller **300** assigns a media identification key, M_1, during step **1215** and creates a record of the media object in the registered media database table **600**. In one embodiment, the identification tags are based on an extended version of the ISCI standard. In a preferred embodiment, the media research controller **300** utilizes a doubly encrypted identification tag to protect the security of the media identification key, which is preferably never made available outside the media research controller **300**. Thus, the assigned media identification key, M_1, is preferably strongly encrypted with a private key, K_1, during step **1220** to produce a payload, C_1. Thereafter, the payload, C_1, is digitally signed with a private key, K_2, to create a digital signature, DS_1, during step **1225** and then the digital signature, DS_1, is prepended to the payload, C_1, during step **1230** to produce a new message, M_2, shown in FIG. **12***b*. It is noted that the new message, M_2, may optionally include bit padding to increase C_1 to a predefined length. Finally, the new message, M_2, is encrypted with a private key, K_3, during step **1235** to produce a real tag, C_2. For a more detailed discussion of suitable encryption and security techniques, see B. Schneier, Applied Cryptography (2d ed. 1997), incorporated by reference herein.

Thereafter, the real tag, C_2, is placed in the media object during step **1240**, or on a simultaneous channel, and also placed in field **660** of the registered media database **600**. The identification tag can be bound to the content in a variety of ways. Preferably, the advertisement or other media is represented as an object, and has been designed to implement the cooperative approach associated with the present invention by reserving a field or sub-object for storing the identification tag. It is important that the identification tag does not interfere in any way with the normal use of the media by any media handler or media handler host that has not implemented the cooperative API described herein. Binding can be generally achieved since the most prevalent media file formats and datatypes support extension through user-defined chunks or objects. As a last resort, the identification tag might be stored within an embedded comment field, into its URL, or even through steganography (hidden codes).

Finally, the media object is released for distribution during step **1245**, before program control ends during step **1250**.

As discussed above, dummy identification tags may be utilized in some content to prevent hostile software from automatically removing advertising media objects. To promote the use of dummy identification tags, they are preferably constructed simply as a random sequence of n bits, as shown in FIG. **12***c*. In an alternate embodiment, the functionality for generating both real and dummy identification tags and encoding the identification tags into the media objects can be performed by third parties, such as advertising agencies or commercial producers, including edit houses or production facilities.

As discussed above, the media research controller **300** preferably executes a data importing process **1300**, shown in FIG. **13**, to receive log dispatches from the remote media research agents **1500**, verify the authenticity and integrity of the received messages and place confirmed entries in the log entry table **800**. As illustrated in FIG. **13**, the media research controller **300** executes the data importing process upon receipt of a log dispatch from a research data collection agent during step **1310**.

Thereafter, the data importing process verifies the authenticity and integrity of the dispatch during step **1320** and then decrypts the dispatch during step **1330**, Finally, the data importing process places all confirmed entries from the dispatch in the log entry database table **800** during step **1340** before program control terminates during step **1350**.

As previously indicated, the media research controller **300** preferably executes a real-time reporting process **1400**, or a non-real-time reporting process **1400'**, to generate reports suited to the needs of a particular research customer **150**. As shown in FIG. **14**, the data importing process **1300**, discussed above, will create records of data received from the research data collection agents **1500** in a central database **370**, from which the reports will be generated. The reports will be formatted to present available data, in a conventional manner, according to the needs one or more research customers **150**. The customers **150** can access the reports over the external networks **130**, or the reports can be printed off-line and provided to the customer **150**, as would be apparent to a person of ordinary skill.

Research Data Collection Agent

As shown in FIG. **15***a*, the research data collection agent **1500** preferably includes a logging process **1510**, a filter process **1530**, a create-dispatch object process **1580** and a dispatch process **1595**, discussed further below in conjunction with FIGS. **15***b*, **15***c*, **15***e* and **15***f*, respectively. The logging process **1510** is executed by the research data collection agent **1500** to receive messages from cooperative media handlers **1700** and create entry objects in an unfiltered media queue **1150**. The filter process **1530** is executed to filter out dummy tags and other unnecessary information from the unfiltered media queue **1150** to create a filtered media queue **1170**. Finally, the research data collection agent **1500** executes the create-dispatch object process **1580** to place the entries from the filtered media queue **1170** into a dispatch queue **1190** for transmission to the media research controller **300**, by the dispatch process **1195** when resources are available. It is noted that the research data collection agent **1500** may also receive information regarding specific transactions made by an associated panel member, from a cooperative financial or end-user transaction process, as would be apparent to a person of ordinary skill, based on the disclosure herein.

As previously indicated, the research data collection agent **1500** executes a logging process **1510**, shown in FIG. **15***b*, to receive messages from the cooperative media handler **1700** and to create entries in the unfiltered media queue **1150**. Thus, the logging process **1510** is entered during step **1515** upon receipt by the research data collection agent **1500** of a message from a cooperative media handler **1700** by means of the host **1600** of the media handler **1700**, containing an extracted identification tag, C_2', if available, and other information. Thereafter, the logging process **1510** creates a log entry object **1100** with the identification tag and other received information in the unfiltered media queue **1150** during step **1520**, which is added to the tail of the unfiltered media queue **1150** during step **1525** before program control terminates during step **1528**.

As discussed above, the research data collection agent **1500** periodically executes a filter process **1530**, shown in FIG. **15***c*, to filter out dummy tags and other unnecessary information from the unfiltered media queue **1150** to create a filtered media queue **1170**. As shown in FIG. **15***c*, the filter process **1530** performs a test during step **1532** to determine if the unfiltered media queue **1150** is empty. If it is determined during step **1532** that the unfiltered media queue **1150** is empty, then program control ends during step **1548**. If, however, it is determined during step **1532** that the unfiltered media queue **1150** is not empty, then a log entry object **1100** is retrieved from the head of the unfiltered media queue **1150** during step **1534**.

Thereafter, a test is performed during step **1535** to determine whether the media research controller **300** has instructed the research data collection agent **1500** to return information only about registered media. If it is determined during step **1535** that the media research controller **300** has not instructed the research data collection agent **1500** to return information only about registered media, then program control proceeds to step **1540**. If, however, it is determined during step **1535** that the media research controller **300** has instructed the research data collection agent **1500** to return information only about registered media, then a decoding subroutine **1550**, discussed below in conjunction with FIG. **15***d*, is executed during step **1536** to determine if the received tag, C_2', stored in the current entry object **1100** of the unfiltered media queue **1150**, contains a real identification tag, which is generally associated with registered media.

After the subroutine **1550** executes, a test is performed during step **1538** to determine if the received tag, C_2', stored in the current log entry object **1100**, contains a real identification tag. If it is determined during step **1538** that the received tag, C_2', stored in the current log entry object **1100**, does not contain a real identification tag, then program control returns directly to step **1532** to process additional log entry objects **1100**, if any. If, however, it is determined during step **1538** that the received tag, C_2', stored in the log entry object **1100**, does contain a real identification tag, then the current log entry object **1100** is placed in the filtered media queue **1170** during step **1540**. Thereafter, program control returns to step **1532** to process additional log entry objects **1100**, if any, in the manner described above.

In this manner, for efficiency purposes, if the research data collection agent **1500** is tasked by the media research controller to report only registered media, then the research data collection agent **1500** preferably only returns log entry objects **100** containing real identification tags to the media research controller **300**. The research data collection agent **1500** preferably does not know, however, whether or not the media object containing a real identification tag is an advertisement. As previously indicated, real identification tags are preferably placed in a small percentage of the advertising-subsidized media objects as a countermeasure against hostile advertising filtering software. Thus, if the research data collection agent's local encryption keys K_2 and K_3 are compromised and obtained by advertising filtering software, the advertising filtering software erroneously filters out some non-advertising media objects. It is noted that advertising filtering software is further discouraged by the preferred selection of challenging encryption techniques, since the research data collection agent **1500** can evaluate the authenticity of a received tag hours after the media is presented, while the advertising filtering software typically would need to decrypt the identification tags in real-time.

As previously indicated, the filter process **1530** executes a decoding subroutine **1550**, shown in FIG. **15***d*, during step **1536** to determine if the received tag, C_2', stored in the current record of the unfiltered media log **1100**, contains a real identification tag. The decoding subroutine **1550** is entered during step **1554**, where the received tag, C_2', is decrypted to create a message, M_2', using the value of the public key, K_3, stored in the local encryption keys database

table **1000**. The decoding subroutine **1550** then creates a digital signature, DS_1', from the first m bits of the message, M_2', and creates C_1' from the remainder during step **1558**.

Thereafter, a test is performed during step **1562** to determine if the digital signature, DS_1', is a valid digital signature of C_1'. If it is determined during step **1562** that the digital signature, DS_1', is a valid digital signature of C_1' then the decoding subroutine returns an indication during step **1564** to the filter process **1530** that the received tag is a real identification tag. If, however, it is determined during step **1562** that the digital signature, DS_1', is not a valid digital signature of C_1' then the decoding subroutine returns an indication during step **1568** to the filter process **1530** that the received tag is an invalid or dummy identification tag. In order to implement the security algorithms discussed in FIG. **15***d*, the research data collection agent **1500** preferably has access to the necessary cryptographic services through its host, and has received the required public keys, K_2 and K_3, by means of a secure distribution method from the media research controller **300**.

As discussed above, the research data collection agent **1500** executes a create-dispatch object process **1580**, shown in FIG. **15***e*, to place entries from the filtered media queue **1170** into a dispatch queue **1190** for transmission by the dispatch process **1190**, shown in FIG. **15***f*, to the media research controller **300**, when resources are available. Initially, the create-dispatch object process **1580** performs a test during step **1581** to determine if the filtered media queue **1170** is empty. If it is determined during step **1581** that the filtered media queue **1170** is empty, then program control ends during step **1582**.

If, however, it is determined during step **1581** that the filtered media queue **1170** is not empty, then a further test is performed during step **1583** to determine if a dispatch object **1130** already exists. If it is determined during step **1583** that a dispatch object **1130** already exists, then program control proceeds directly to step **1585**. If, however, it is determined during step **1583** that a dispatch object **1130** does not already exist, then a new dispatch object **1130** is created during step **1584**.

Thereafter, a log entry object **1100** is retrieved from the head of the filtered media queue **1150** during step **1585**, and placed in the dispatch object **1130**. Thereafter, a test is performed during step **1587** to determine if the filtered media queue **1170** is empty or if the dispatch object **1130** is full. If it is determined during step **1585** that the filtered media queue **1170** is not empty and that the dispatch object **1130** is not full, then program control returns to step **1581** to continue processing additional log entry objects **1100** from the filtered media queue **1170**, if any.

If, however, it is determined during step **1585** that the filtered media queue **1170** is empty or that the dispatch object **1130** is full, then the dispatch object **1130** will be compressed and digitally signed during step **1588**. Thereafter, the compressed dispatch object **1130** will preferably be encrypted during step **1589** using the public key, K_4, of the media research controller **300**. Finally, the compressed and encrypted dispatch object **1130** will be added to the tail of the dispatch queue **1190** during step **1590** and program control returns to step **1581** and continues in the manner discussed above.

As previously indicated, a dispatch process **1595**, shown in FIG. **15***f*, transmits dispatch objects **1130** from the dispatch queue **1190** to the media research controller **300**, when resources are available. Thus, a test is initially performed during step **1596** to determine if the dispatch queue **1190** is empty. If it is determined during step **1596** that the dispatch queue **1190** is empty, then program control terminates during step **1597**. If, however, it is determined during step **1596** that the dispatch queue **1190** is not empty, then a dispatch object **1130** is removed from the head of the dispatch queue **1190** during step **1598** and sent to the media research controller **300** during step **1599**. Thereafter, program control returns to step **1596** to process additional dispatch objects **1130**, if any, in the manner described above.

Host Process(es)

As previously indicated, the RDC/cooperative media handler host **1600** preferably executes a tracking process **1605**, shown in FIG. **16**, to notify the hosted research data collection agents **1500** when a panel member enters or exits the agent's scope. In addition, as discussed above, the research data collection agents **1500** and the cooperative media handlers **1700** preferably rely on services and resources provided by the host processes for processing, security, storage and communication. In the illustrative embodiment discussed herein, an Internet browser software product, such as Netscape Navigator™ or Microsoft Internet Explorer™, resident on the panel member-computing device **400**, serves as the host for both the research data collection agent **1500** and the cooperative media handler **1700** and provides them with computational resources.

Thus, as shown in FIG. **16**, an illustrative tracking process **1605** continuously reports when a panel member enters or exits its scope during step **1610**. Once the tracking process **1605** determines that a panel member has entered the scope of a research data collection agent, a message is sent to the hosted research data collection agent **1500** during step **1620** monitoring the panel member indicating that a panel member has entered the agent's scope.

Thereafter, the tracking process **1605** continuously monitors the panel member during step **1630** until the panel member leaves the scope of the hosted research data collection agent **1500**. If it is determined during step **1630** that the panelist has left the scope of the hosted research data collection agent **1500**, then a message is sent to the hosted research data collection agent **1500** during step **1640** indicating that a panel member has left the agent's scope. A test is then performed during step **1645** to determine if tracking should be suspended. If it is determined during step **1645** that tracking should not be suspended, then program control returns to step **1610** to continue tracking, in the manner described above. If, however, it is determined during step **1645** that tracking should be suspended, then program control terminates during step **1650**.

Cooperative Media Handlers

As discussed above, the cooperative media handler process **1700**, shown in FIG. **17**, preferably presents media objects and extracts information from, or otherwise obtains information about, presented media objects, including identification tags, if present, for collection by research data collection agents **1500**, whether or not a research data collection agent **1500** is actually present. In an alternate implementation, the cooperative media handler **1700** can transmit all information obtained about a media object directly to the media research controller **300** and perform all other tasks associated with the research data collection agents **1500**. In other words, the cooperative media handler **1700** can directly serve as the software agent of the media research controller **300**, without the need of an intermediary research data collection agent **1500**, as would be apparent to a person of ordinary skill.

In one embodiment, the media handler **1700** is provided with one or more remotely configurable settings which may be dynamically specified by the research data collection agent **1500** or the media research controller **300** to help filter out information which is not of interest to the research data collection agent **1500**. Alternatively, the media handler **1700** can query its host to identify the information of interest to the research data collection agent **1500**. If, however, the host does not want to inform the media handler **1700** that no research data collection agent **1500** is present, the host might have the media handler **1700** pass everything. Thus, the media handler **1700** preferably reports information according to instructions received from the research data collection agent **1500** via its host.

As shown in FIG. **17**, a cooperative media handler **1700** is initiated by its host **1600'**, such as the illustrative Internet browser, upon receipt of a media object having a media type that is compatible with the media handler. Thereafter, the media handler process **1700** decodes and parses the media object during step **1705**, in a known manner. A test is then performed during step **1710** to determine if there is media object information associated with the media object, such as an identification tag, metadata or contextual information. As previously indicated, metadata may include program identification information and the corresponding media type and contextual information may include the URL and other information indicating the source of the corresponding media object, or the context in which it was presented to the end user. If it is determined during step **1710** that there is media object information associated with the media object, then a test is performed during step **1785** to determine if a message has already been created for the research data collection agent **1500**. If it is determined during step **1785** that a message has already been created for the research data collection agent **1500**, then program control proceeds directly to step **1795**. If, however, it is determined during step **1785** that a message has not yet been created for the research data collection agent **1500**, then a message is created during step **1790**.

Thereafter, the media object information identified during step **1710** is added to the agent message during step **1795**. Thereafter, a further test is performed during step **1720** to determine if there is media to present to a user. If it is determined during step **1720** that there is no media to present to a user, then program control proceeds directly to step **1740**. If, however, it is determined during step **1720** that there is media to present to a user, then a conventional presentation process is performed during step **1725** to present the media. A test is then performed during step **1730** to determine if there is presentation information to report to the research data collection agent **1500**. As previously indicated, presentation information may include the language and format in which the media object was presented to the panel member, or other information indicating how the object was presented to the panel member, when alternative presentations are possible. If it is determined during step **1730** that there is no presentation information to report to the research data collection agent **1500**, then program control proceeds directly to step **1760**. If, however, it is determined during step **1730** that there is presentation information to report to the research data collection agent **1500**, then the presentation information identified during step **1730** is added to the message during step **1735**.

A test is performed during step **1740** to determine if user interactions are received during the presentation of the media object. If it is determined during step **1740** that user interactions are received during the presentation of the media object, then program control proceeds directly to step **1760**. If, however, it is determined during step **1740** that user interactions are received during the presentation of the media object, then the user interactions are received and processed during step **1745**. A test is then performed during step **1750** to determine if there is user interaction information to report to the research data collection agent **1500**. As previously indicated, user interaction information may specify how the panel member interacted with the object, including whether the panel member zoomed in on portions of the media object, or rotated the object, as well as the size of the media object and any user inputs.

If it is determined during step **1750** that there is no user interaction information to report to the research data collection agent **1500**, then program control proceeds directly to step **1760**. If, however, it is determined during step **1750** that there is user interaction information to report to the research data collection agent **1500**, then the user interaction information identified during step **1750** is added to the message during step **1755**.

A test is performed during step **1760** to determine if the presentation of the media object is finished. If it is determined during step **1760** that the presentation of the media object is not finished, then program control will return to step **1705** to continue processing in the manner described above. If, however, it is determined during step **1760** that the presentation of the media object is finished, then a test is performed during step **1765** to determine if there is a message to be sent to the research data collection agent **1500**. If it is determined during step **1765** that there is a message to be sent to the research data collection agent **1500**, then the message is completed during step **1770**, for example, by adding media handler identifying information, and a final time and date stamp. Thereafter, the completed message is sent to the research data collection agent **1500**. Program control will then terminate during step **1780**.

It is to be understood that the embodiments and variations shown and described herein are merely illustrative of the principles of this invention and that various modifications may be implemented by those skilled in the art without departing from the scope and spirit of the invention.

I claim:

1. A method performed by an independent research entity for measuring the exposure of an individual to electronic media, said method comprising the steps of:

associating one or more software agents with said individual, said one or more software agents being agents of said independent research entity, said one or more software agents obtaining information identifying said electronic media from one or more cooperative media handlers provided by a second entity using a defined interface that provides interoperability between said one or more software agents and said one or more cooperative media handlers such that each of said one or more software agents and said one or more cooperative media handlers can communicate without regard to an implementation of the defined interface of the other, said one or more cooperative media handlers providing said information identifying said electronic media to said one or more software agents; and

obtaining a message from said one or more software agents containing said obtained information identifying said electronic media.

2. The method according to claim **1**, wherein said message further comprises information identifying said individual who was presented with said electronic media associated with said obtained information identifying said electronic media.

3. The method according to claim 1, wherein said measurement method is transparent to said individual and does not impose a substantial computational load on a computing device used by said individual.

4. The method according to claim 1, further comprising the step of generating reports on said exposure.

5. The method according to claim 1, wherein at least one of said cooperative media handlers further comprises the step of measuring the interactions of said individual with said electronic media.

6. The method according to claim 1, wherein said individual is chosen for the individual's demographics and has agreed to participate in a research panel to have the individual's exposure to and interactions with said electronic media measured.

7. The method according to claim 1, further comprising the step of providing a software agent for each computing device utilized by said individual.

8. The method according to claim 1, wherein said information identifying said electronic media is an identification tag and further comprising the step of placing identification tags at periodic intervals throughout the duration of continuous electronic media.

9. The method according to claim 1, further comprising the step of placing real identification tags in said electronic media that is registered.

10. The method according to claim 9, further comprising the steps of:

placing dummy identification tags in at least a portion of electronic media that is not registered; and

determining whether one of said identification tags is a real identification tag associated with said electronic media that is registered or a dummy identification tag.

11. The method according to claim 1, further comprising the step of placing real identification tags in at least a portion of electronic media that is not registered.

12. The method according to claim 1, further comprising the step of placing dummy identification tags in at least a portion of electronic media that is not registered.

13. The method according to claim 1, further comprising the step of receiving information identifying said electronic media from at least one of said cooperative media handlers in order that electronic media presented to said individual not containing an identification tag may be measured.

14. The method according to claim 1, wherein said one or more cooperative media handlers may be remotely configured to specify which portions of said information identifying said electronic media to obtain and provide to said software agent.

15. The method according to claim 1, wherein said one or more cooperative media handlers filter said information identifying said electronic media, such that only a portion of said information identifying said electronic media is provided to said software agent.

16. The method according to claim 1, wherein said one or more cooperative media handlers filter said information identifying said electronic media, such that only a portion of said information identifying said electronic media is provided to a research facility measuring the exposure of said individual to electronic media.

17. The method according to claim 1, wherein said one or more cooperative media handlers further comprise the step of measuring the interactions of said individual with said electronic media.

18. The method according to claim 1, wherein said information identifying said electronic media is an identification tag.

19. The method according to claim 1, wherein said information identifying said electronic media comprises metadata.

20. The method according to claim 1, wherein said information identifying said electronic media comprises presentation information.

21. The method according to claim 1, wherein said information identifying said electronic media comprises any contextual information made available to the one or more cooperative media handlers by its host.

22. The method of claim 1, wherein said individual is part of an audience.

23. The method of claim 1, wherein said individual is part of a research panel chosen as a sample to statistically represent a larger population.

24. The method of claim 1, further comprising the steps of identifying and authenticating said individual.

25. The method of claim 1, wherein said defined interface utilizes an application programming interface (API).

26. The method of claim 1, wherein said defined interface utilizes an open communication protocol.

27. The method of claim 1, wherein said electronic media includes an advertisement.

28. The method of claim 1, wherein said electronic media is a software component.

29. The method of claim 1, wherein at least one of said cooperative media handlers decodes and presents said electronic media obtained from a local storage device.

30. The method of claim 1, wherein at least one of said cooperative media handlers decodes and presents said electronic media obtained from a wired network connection.

31. The method of claim 1, wherein at least one of said cooperative media handlers decodes and presents said electronic media obtained from a wireless network connection.

32. The method of claim 1, wherein said electronic media is presented using an Internet-enabled device.

33. The method of claim 1, wherein said at least one of said cooperative media handlers decodes and presents said electronic media generated in real-time.

34. The method of claim 1, wherein at least one of said cooperative media handlers is a software component that temporarily extends the capabilities of its host to present media.

35. The method of claim 1, wherein at least one of said cooperative media handlers is a persistent software component that extends the capabilities of a software application to present media objects of a particular media type to an individual.

36. The method of claim 1, wherein at least one of said cooperative media handlers is a persistent software component that extends the capabilities or an operating system to present media objects of a particular media type to an individual.

37. The method of claim 1, wherein at least one of said cooperative media handlers is mobile.

38. The method of claim 1, wherein at least one of said cooperative media handlers is stable.

39. The method of claim 1, wherein at least one of said software agents obtains said information identifying said electronic media by receiving a communication from said cooperative media handler.

40. The method of claim 1, wherein at least one of said software agents obtains said information identifying said electronic media by retrieving said information identifying said electronic media made available by said cooperative media handler.

41. A method performed by a cooperative media handler for presenting electronic media to an individual, said method comprising the steps of:

decoding said electronic media;

obtaining information identifying said electronic media;

presenting said electronic media to said individual; and

providing said obtained information to a software agent using a defined interface that provides interoperability with said software agent, such that said software agent and said cooperative media handler can communicate without regard to an implementation of the defined interface of the other, said software agent being assigned to track said individual on behalf of an independent research entity.

42. The method according to claim **41**, further comprising the step of remotely configuring said cooperative media handler to specify which portions of said information identifying said electronic media to obtain and provide to said software agent.

43. The method according to claim **41**, further comprising the step of filtering said information provided to said software agent.

44. The method according to claim **41**, wherein said cooperative media handler further comprises the step of measuring the interactions of said individual with said electronic media.

45. The method according to claim **41**, wherein said obtained information is an identification tag.

46. The method according to claim **41**, wherein said obtained information includes metadata.

47. The method according to claim **41**, wherein said obtained information includes contextual information.

48. The method according to claim **41**, wherein a software agent is preferably associated with each computing device utilized by a given individual.

49. A method performed by a cooperative media handler for presenting electronic media to an individual, said method comprising the steps of:

decoding said electronic media;

obtaining information identifying said electronic media;

presenting said electronic media to said individual;

adhering to a defined interface that provides interoperability with a software agent associated with said individual, such that said software agent and said cooperative media handler can communicate without regard to an implementation of the defined interface of the other, said software agent being an agent of an independent research facility measuring the exposure of said individual to electronic, media; and

providing said obtained information and information identifying said individual to said software agent using said defined interface.

50. The method according to claim **49**, wherein said obtained information is provided directly to said independent research facility.

51. The method according to claim **49**, wherein said obtained information is provided indirectly to said independent research facility by means of a software agent assigned to track said individual.

52. The method according to claim **49**, wherein said obtained information is an identification tag.

53. The method according to claim **49**, wherein said obtained information is a program descriptor.

54. A cooperative media handler for presenting electronic media to a member of a research panel, comprising:

means for decoding said electronic media;

means for obtaining information identifying said electronic media;

means for presenting said electronic media to said member;

a defined interface that provides interoperability with a software agent associated with said individual, such that said software agent and said cooperative media handler can communicate without regard to an implementation of the defined interface of the other, said software agent being an agent of an independent research facility measuring the exposure of said individual to electronic media; and

means for providing said obtained information and information identifying said individual to said software agent using said defined interface.

55. The cooperative media handler according to claim **54**, wherein said obtained information is provided directly to said independent research facility.

56. The cooperative media handler according to claim **54**, wherein said obtained information is provided indirectly to said independent research facility by means of a software agent assigned to track said individual.

57. The cooperative media handler according to claim **54**, wherein said obtained information is an identification tag.

58. The cooperative media handler according to claim **54**, wherein said obtained information is metadata associated with said electronic media.

59. A method performed by a software agent of a research entity measuring the exposure of an individual to electronic media, said method comprising the steps of:

receiving information identifying said electronic media from one or more cooperative media handlers provided by a second entity using a defined interface that provides interoperability with said one or more cooperative media handlers, such that said software agent and each of said one or more cooperative media handlers can utilize said defined interface to communicate without regard to an implementation of the defined interface of the other; and

providing a message containing at least a portion of said information to said research entity measuring the exposure of said individual to electronic media.

60. The method according to claim **59**, wherein said measurement method is transparent to said individual and does not impose a substantial computational load on a computing device used by said individual.

61. The method according to claim **59**, wherein a software agent is preferably associated with each computing device utilized by a given individual.

62. The method according to claim **61**, wherein said software agent filters said messages provided to said research entity.

63. A method of obtaining information identifying an electronic media object, said method comprising the steps of:

providing a cooperative media handler to decode said electronic media object, said cooperative media handler obtaining said information from said electronic media;

presenting said electronic media object to an individual; and

providing said obtained information for collection by a software agent using a defined interface that provides interoperability between said software agent and said cooperative media handler, such that said software agent and said cooperative media handler can utilize said defined interface to communicate without regard to an implementation of the defined interface of the other, said software agent being assigned to track one or more individuals on behalf of an independent research entity.

64. The method according to claim **63**, further comprising the step of generating reports on said exposure.

65. The method according to claim **63**, further comprising the step of measuring the interactions of said individual with said electronic media.

66. The method according to claim **63**, further comprising the step of providing a software agent for each computing device utilized by a given panel member.

67. A method performed by an independent research entity for measuring the exposure of an individual to electronic media, said method comprising the steps of:

establishing an interface for communications between a research data collection agent and a plurality of cooperative media handlers, said defined interface permitting said research data collection agent and each of said cooperative media handlers to communicate without regard to an implementation of the defined interface of the other, wherein said cooperative media handlers present media to said individual and gather presentation information about media presentations and wherein said research data collection agent collects said presentation information from said cooperative media handlers on behalf of said independent research entity; and

associating at least one research data collection agent with said individual, said research data collection agent adhering to said interface, said research data collection agent obtaining presentation information from said cooperative media handlers by means of said interface and forwarding at least a portion of said presentation information to said independent research entity.

68. The method according to claim **67**, wherein said presentation information further comprises information identifying said individual who was presented with said electronic media.

69. The method according to claim **67**, further comprising the step of generating reports on said exposure.

70. The method according to claim **67**, wherein at least one of said cooperative media handlers further comprises the step of measuring the interactions of said individual with said electronic media.

71. The method according to claim **67**, wherein said individual is chosen for the individual's demographics and has agreed to participate in a research panel to have the individual's exposure to and interactions with said electronic media measured.

72. The method according to claim **67**, further comprising the step of receiving information identifying said electronic media from at least one of said cooperative media handlers in order that electronic media presented to said individual not containing an identification tag may be measured.

73. The method according to claim **67**, wherein said one or more cooperative media handlers may be remotely configured to specify which portions of said presentation information to obtain and provide to said research data collection agent.

74. The method according to claim **67**, wherein said one or more cooperative media handler filter said presentation information such that only a portion of said presentation information is provided to said software agent.

75. The method according to claim **67**, wherein said one or more cooperative media handlers filter said presentation information such that only a portion of said presentation information is provided to a research facility measuring the exposure of said individual to electronic media.

76. The method according to claim **67**, wherein said one or more cooperative media handlers further comprise the step of measuring the interactions of said individual with said electronic media.

77. The method according to claim **67**, wherein said presentation information includes an identification tag.

78. The method according to claim **67**, wherein said presentation information comprises metadata.

79. The method according to claim **67**, wherein said presentation information comprises any contextual information made available to the one or more cooperative media handlers by its host.

80. The method according to claim **67**, wherein said individual is part of an audience.

81. The method according to claim **67**, wherein said individual is part of a research panel chosen as a sample to statistically represent a larger population.

82. The method according to claim **67**, further comprising the steps of identifying and authenticating said individual.

83. The method according to claim **67**, wherein said defined interface utilizes an application programming interface (API).

84. The method according to claim **67**, wherein said defined interface utilizes an open communication protocol.

85. The method according to claim **67**, wherein said electronic media includes an advertisement.

86. The method according to claim **67**, wherein said electronic media is a software component.

87. The method according to claim **67**, wherein at least one of said cooperative media handlers decodes and presents said electronic media obtained from a local storage device.

88. The method according to claim **67**, wherein at least one of said cooperative media handlers decodes and presents said electronic media obtained from a wired network connection.

89. The method according to claim **67**, wherein at least one of said cooperative media handlers decodes and presents said electronic media obtained from a wireless network connection.

90. The method according to claim **67**, wherein said electronic media is presented using an Internet-enabled device.

91. The method according to claim **67**, wherein said at least one of said cooperative media handlers decodes and presents said electronic media generated in real-time.

92. The method according to claim **67**, wherein at least one of said cooperative media handlers is a software component that temporarily extends the capabilities of its host to present media.

93. The method according to claim **67**, wherein at least one of said cooperative media handlers is a persistent software component that extends the capabilities of a software application to present media objects of a particular media type to an individual.

94. The method according to claim **67**, wherein at least one of said cooperative media handlers is a persistent software component that extends the capabilities of an operating system to present media objects of a particular media type to an individual.

95. The method according to claim **67**, wherein at least one of said cooperative media handlers is mobile.

96. The method according to claim **67**, wherein at least one of said cooperative media handler is stable.

97. The method according to claim **67**, wherein at least one of said research data collection agents obtains said presentation information by receiving a communication from at least one of said cooperative media handlers.

98. The method according to claim **67**, wherein at least one of said research data collection agents obtains said presentation information identifying said electronic media by retrieving said information identifying said electronic media made available by at least one of said cooperative media handlers.

99. A cooperative system employed by an independent research entity for measuring the exposure of an individual to electronic media, said cooperative system comprising:

a memory that stores computer-readable code;

a processor operatively coupled to said memory, said processor configured to execute said computer-readable code, said computer-readable code configured to associate one or more software agents with said individual, said one or more software agents being agents of said independent research entity, said one or more software agents obtaining information identifying said electronic media from one or more cooperative media handlers provided by a second entity using a defined interface that provides interoperability between said one or more software agents and said one or more cooperative media handlers such that each of said one or more software agents and each of said one or more cooperative media handlers can communicate without regard to an implementation of the defined interface of the other, said cooperative media handler providing said information identifying said electronic media to said one or more software agents; and

a communication port that obtains a message from said software agent containing said obtained information identifying said electronic media.

100. The cooperative system according to claim **99**, wherein said message further comprises information identifying said individual who was presented with said electronic media associated with said obtained information identifying said electronic media.

101. The cooperative system according to claim **99**, wherein said processor is further configured to generate reports on said exposure.

102. The cooperative system according to claim **99**, wherein said processor is further configured to receive information identifying said electronic media in order that electronic media presented to said individual not containing an identification tag may be measured.

103. The cooperative system according to claim **99**, wherein said one or more cooperative media handlers may be remotely configured to specify which portions of said information identifying said electronic media to obtain and provide to said software agent.

104. The cooperative system according to claim **99**, wherein said one or more cooperative media handlers are configured to measure the interactions of said individual with said electronic media.

105. The method according to claim **99**, wherein said information includes an identification tag.

106. The cooperative system according to claim **99**, wherein said defined interface utilizes an application programming interface (API).

107. The cooperative system according to claim **99**, wherein said defined interface utilizes an open communication protocol.

108. The cooperative system according to claim **99**, wherein said electronic media includes an advertisement.

109. The cooperative system according to claim **99**, wherein said electronic media is a software component.

110. The cooperative system according to claim **99**, wherein at least one of said cooperative media handlers decodes and presents said electronic media obtained from a local storage device.

111. The cooperative system according to claim **99**, wherein at least one of said cooperative media handlers decodes and presents said electronic media obtained from a wired network connection.

112. The cooperative system according to claim **99**, wherein at least one of said cooperative media handlers decodes and presents said electronic media obtained from a wireless network connection.

113. The cooperative system according to claim **99**, wherein said electronic media is presented using an Internet-enabled device.

114. The cooperative system according to claim **99**, wherein said at least one of said cooperative media handlers decodes and presents said electronic media generated in real-time.

115. The cooperative system according to claim **99**, wherein at least one of said cooperative media handlers is a software component that temporarily extends the capabilities of its host to present media.

116. The cooperative system according to claim **99**, wherein at least one of said cooperative media handlers is a persistent software component that extends the capabilities of a software application to present media objects of a particular media type to an individual.

117. The cooperative system according to claim **99**, wherein at least one of said cooperative media handlers is a persistent software component that extends the capabilities of an operating system to present media objects of a particular media type to an individual.

118. The cooperative system according to claim **99**, wherein at least one of said cooperative media handlers is mobile.

119. The cooperative system according to claim **99**, wherein at least one of said cooperative media handlers is stable.

120. A cooperative system for presenting electronic media to an individual, said cooperative system comprising:

a memory that stores computer-readable code; and

a processor operatively coupled to said memory, said processor configured to execute said computer-readable code, said computer-readable code containing:

cooperative media handler instructions to:

present media to said individual; and

gather presentation information about media presentations;

research data collection agent instructions to collect said presentation information on behalf of an independent research entity; and

an interface for communications between a research data collection agent and a plurality of cooperative media handlers, said defined interface permitting

said research data collection agent and each of said cooperative media handlers to communicate without regard to an implementation of the defined interface of the other.

121. The cooperative system according to claim **120**, wherein said cooperative media handler instructions further include instructions to measure the interactions of said individual with said electronic media.

122. The cooperative system according to claim **120**, wherein said cooperative media handler instructions further include instructions to filter said presentation information such that only a portion of said presentation information is provided to said software agent.

123. The cooperative system according to claim **120**, wherein said cooperative media handler instructions further include instructions to filter said presentation information such that only a portion of said presentation information is provided to a research facility measuring the exposure of said individual to electronic media.

124. The cooperative system according to claim **120**, wherein said cooperative media handler instructions further include instructions to measure the interactions of said individual with said electronic media.

125. The cooperative system according to claim **120**, wherein said defined interface utilizes an application programming interface (API).

126. The cooperative system according to claim **120**, wherein said defined interface utilizes an open communication protocol.

* * * * *

US006031577A

United States Patent [19]

Ozkan et al.

[11] **Patent Number:** **6,031,577**

[45] **Date of Patent:** **Feb. 29, 2000**

[54] **SYSTEM FOR FORMING AND PROCESSING PROGRAM SPECIFIC INFORMATION CONTAINING TEXT DATA FOR TERRESTRIAL, CABLE OR SATELLITE BROADCAST**

[75] Inventors: **Mehmet Kemal Ozkan**, Indianapolis, Ind.; **Chia-Yuan Teng**, San Diego, Calif.; **Edwin Arturo Heredia**, Indianapolis, Ind.

[73] Assignee: **Thomson Consumer Electronics, Inc.**, Indianapolis, Ind.

[21] Appl. No.: **09/057,648**

[22] Filed: **Apr. 9, 1998**

Related U.S. Application Data

[60] Provisional application No. 60/052,152, Jul. 10, 1997.

[51] **Int. Cl.**[7] **H04N 2/00**

[52] **U.S. Cl.** **348/465**; 348/906

[58] **Field of Search** 348/906, 465, 348/468, 384, 553, 467, 725, 564, 569; 345/327, 328

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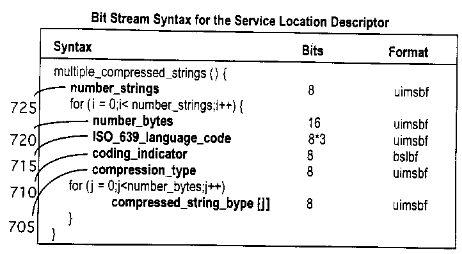
Primary Examiner—Victor R. Kostak

Attorney, Agent, or Firm—Joseph S. Tripoli; Ronald H. Kurdyla; Alexander J. Burke

[57] **ABSTRACT**

Packetized program information used in video processing and storage medium formats includes multiple text strings. A decoder decodes packetized program information containing multiple text strings associated with a program. The decoder determines from a first indicator in the packetized program information a type of coding and compression employed in encoding a first text string. The decoder decodes the first text string with a decoding function selected in accordance with the determined type of coding and assembles decoded text string elements to form an output text string.

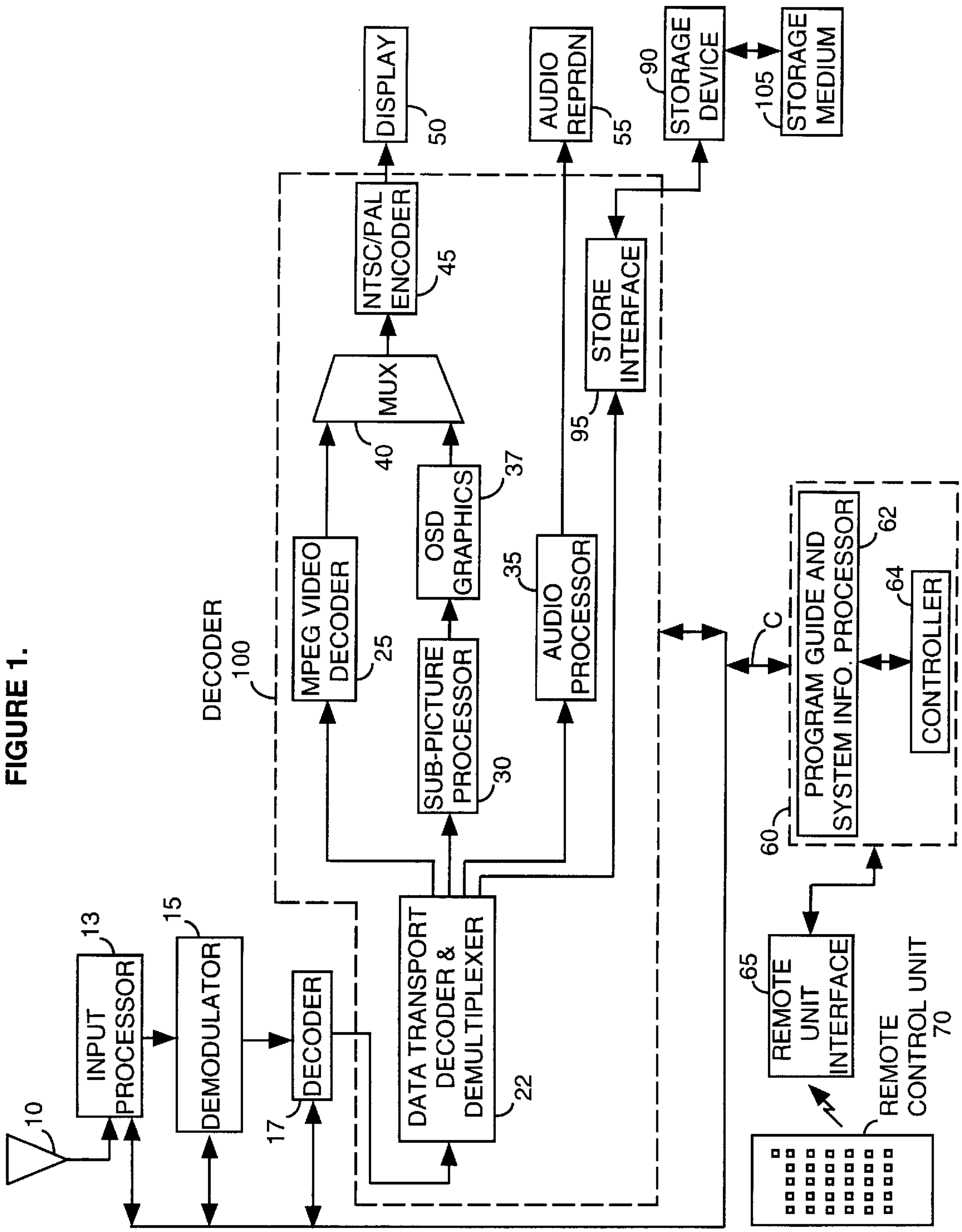
20 Claims, 7 Drawing Sheets



compression_type	compression method
0x00	No compression
0x01	Huffman coding based on the default Huffman table
0x02	LZW
0x03 to 0xAF	reserved
0xB0 to 0xFF	user private

coding_indicator	coding method
0x00	Unicode
0x01	Latin-1
0x02	Latin-2
0x03 to 0xAF	reserved
0xB0 to 0xFF	user private

FIGURE 1.


10
INPUT PROCESSOR
13
DEMODULATOR
15
DECODER
17
DATA TRANSPORT DECODER & DEMULTIPLEXER
22
DECODER
100
MPEG VIDEO DECODER
25
SUB-PICTURE PROCESSOR
30
OSD GRAPHICS
37
AUDIO PROCESSOR
35
MUX
40
NTSC/PAL ENCODER
45
DISPLAY
50
AUDIO REPRDN
55
STORE INTERFACE
95
STORAGE DEVICE
90
STORAGE MEDIUM
105
C
PROGRAM GUIDE AND SYSTEM INFO. PROCESSOR
62
CONTROLLER
64
60
REMOTE UNIT INTERFACE
65
REMOTE CONTROL UNIT
70

Bit Stream Syntax for the Master Guide Table

	Syntax	Bits	Format
	master_guide_table_section () {		
	table_id	8	0xE0
	section_syntax_indicator	1	'1'
	private_indicator	1	'1'
	reserved	2	'11'
	private_section_length	12	uimsbf
	table_id_extension	16	0x0000
	reserved	2	'11'
	version_number	5	uimsbf
	current_next_indicator	1	'1'
	section_number	8	0x00
	last_section_number	8	0x00
	reserved	3	'111'
	CRT _version_number	5	uimsbf
	zero	4	'0000'
	num_pg	4	uimsbf
	for (i =0;i< num_pg;i++) PG(i) {		
220	application_time	40	uimsbf
215	duration	16	uimsbf
	reserved	2	'11'
	CIT _flag	1	blsbf
	num_bytes	21	uimsbf
	reserved	3	'111'
210	PID_PG [i]	13	uimsbf
	reserved	3	'111'
205	PID_ETT [i]	13	uimsbf
	reserved	4	uimsbf
	PG _descriptors_length	12	uimsbf
	for(j = 0;i< M;j++)		
	descriptor ()	var	
	}		
	reserved	4	uimsbf
	descriptors_length	12	uimsbf
	for (i = 0;i< N;j++)		
	descriptor ()	var	
	CRC _32	32	rpchof
	}		

FIGURE 2

Bit Stream Syntax for the Channel Information Table

	Syntax	Bits	Format
	channel_guide_table_section () {		
	table_id	8	0xE3
	section_syntax_indicator	1	'1'
	private_indicator	1	'1'
	reserved	2	'11'
	section_length	12	uimsbf
	table_id_extension	16	uimsbf
	reserved	2	'11'
	version_number	5	uimsbf
	current_next_indicator	1	'1'
	section_number	8	uimsbf
	last_section_number	8	uimsbf
	num_channels_in_section	8	uimsbf
	for (k=0; k<num_channels_in_section;k ++) cha_info(k){		
	short_name	8*6	ISO-639
340	**channel_visibility**	32	bslbf
	bundle_channel_number{		
	bundle_number	12	uimsbf
	channel_number_in_bundle	12	uimsbf
300	}		
305	**Channel_PTC**	8	uimsbf
	channel_id	16	uimsbf
315	**channel_type**	8	uimsbf
	reserved	3	'111'
320	**ETM_flag**	1	bslbf
	descriptors_length	12	uimsbf
325	for (i=0;i<N;i++){		
	descriptors()		
330	}		
	}		
	CRC_32	32	rpchof
335	}		

FIGURE 3

Bit Stream Syntax for the Service Location Descriptor

	Syntax	Bits	Format
	service_location_descriptor () {		
	descriptor_tag	8	uimsbf
	descriptor_length	8	uimsbf
405	**program_number**	16	uimsbf
	reserved	3	'111'
410	**PCR_PID**	13	uimsbf
	number_PIDs	8	uimsbf
	for (i=1;i<number_PIDs;i++){		
415	**stream_type**	8	uimsbf
	reserved	3	bslbf
420	**elementary_PID**	13	uimsbf
425	**ISO_639_language_code**	8*3	uimsbf
	}		
	}		

FIGURE 4

Bit Stream Syntax for the Service Location Descriptor

	Syntax	Bits	Format
	extended_text_table_section () {		
	table_id	8	0xE5
	section_syntax_indicator	1	'0'
	private_indicator	1	'1'
	reserved	2	'11'
	private_section_length	12	uimsbf
510	ETM_id	32	bslbf
505	extended_text_message ()	var	
	}		

FIGURE 5

	Bit	1	2	3 ... 18	19 ... 32
610	channel ETM_id	0	0	channel_id	111.......................111
605	event ETM_id	1	0	channel_id	event_id

FIGURE 6

Bit Stream Syntax for the Service Location Descriptor

	Syntax	Bits	Format
	multiple_compressed_strings () {		
	number_strings	8	uimsbf
725	for (i = 0;i< number_strings;i++) {		
	number_bytes	16	uimsbf
720	**ISO_639_language_code**	8*3	uimsbf
	coding_indicator	8	bslbf
715	**compression_type**	8	uimsbf
710	for (j = 0;j<number_bytes;j++)		
	compressed_string_bype [j]	8	uimsbf
705	}		
	}		

FIGURE 7

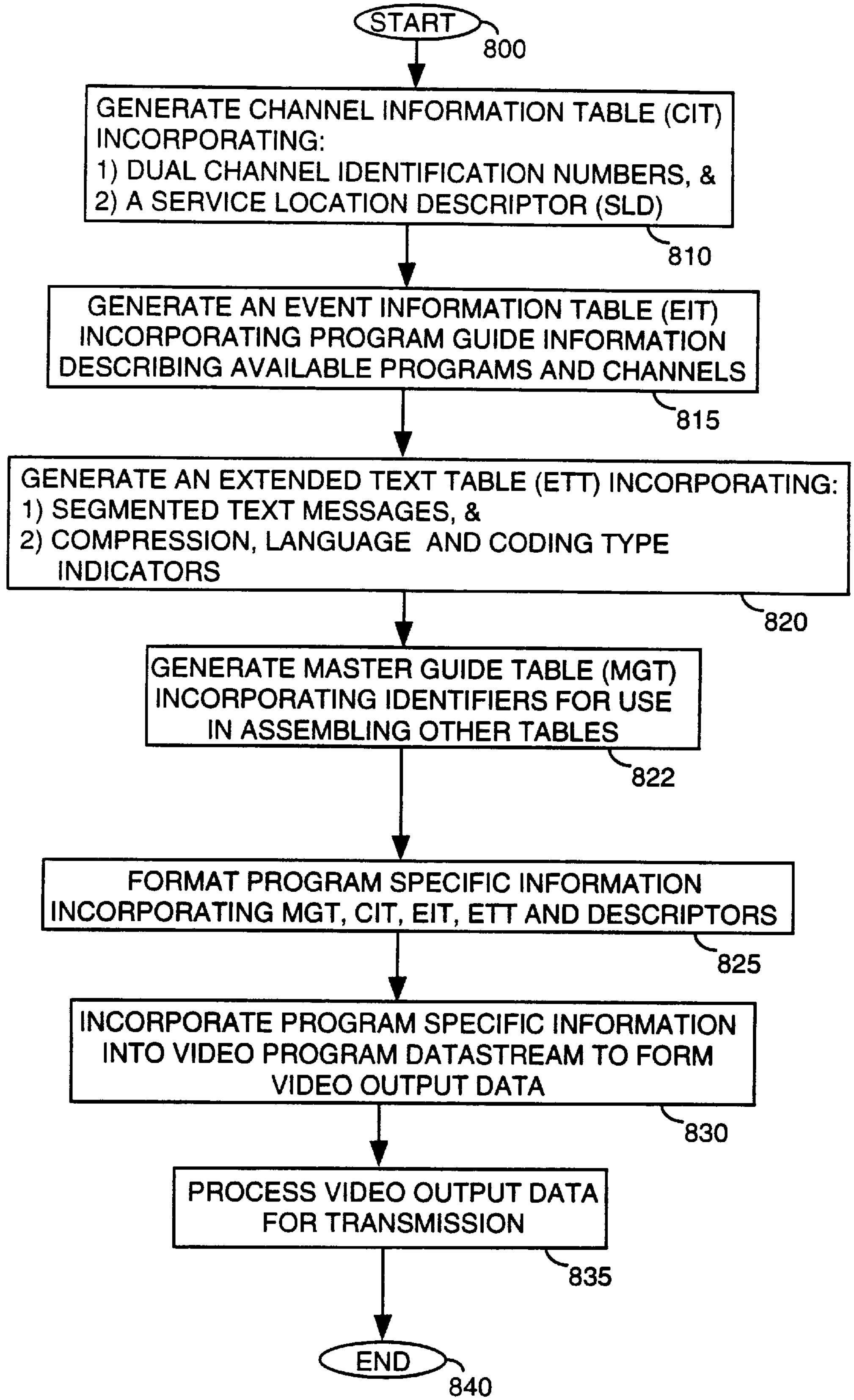
compression_type	compression method
0x00	No compression
0x01	Huffman coding based on the default Huffman table
0x02	LZW
0x03 to 0xAF	reserved
0xB0 to 0xFF	user private

FIGURE 8

coding_indicator	coding method
0x00	Unicode
0x01	Latin-1
0x02	Latin-2
0x03 to 0xAF	reserved
0xB0 to 0xFF	user private

FIGURE 9

FIGURE 10


START
800
GENERATE CHANNEL INFORMATION TABLE (CIT) INCORPORATING:
1) DUAL CHANNEL IDENTIFICATION NUMBERS, &
2) A SERVICE LOCATION DESCRIPTOR (SLD)
810
GENERATE AN EVENT INFORMATION TABLE (EIT) INCORPORATING PROGRAM GUIDE INFORMATION DESCRIBING AVAILABLE PROGRAMS AND CHANNELS
815
GENERATE AN EXTENDED TEXT TABLE (ETT) INCORPORATING:
1) SEGMENTED TEXT MESSAGES, &
2) COMPRESSION, LANGUAGE AND CODING TYPE INDICATORS
820
GENERATE MASTER GUIDE TABLE (MGT) INCORPORATING IDENTIFIERS FOR USE IN ASSEMBLING OTHER TABLES
822
FORMAT PROGRAM SPECIFIC INFORMATION INCORPORATING MGT, CIT, EIT, ETT AND DESCRIPTORS
825
INCORPORATE PROGRAM SPECIFIC INFORMATION INTO VIDEO PROGRAM DATASTREAM TO FORM VIDEO OUTPUT DATA
830
PROCESS VIDEO OUTPUT DATA FOR TRANSMISSION
835
END
840

SYSTEM FOR FORMING AND PROCESSING PROGRAM SPECIFIC INFORMATION CONTAINING TEXT DATA FOR TERRESTRIAL, CABLE OR SATELLITE BROADCAST

This is a non-provisional application of provisional application Ser. No. 60/052,152 by E. A. Heredia et al, filed Jul. 10, 1997.

FIELD OF THE INVENTION

This invention is related to the formation of Program Guides, system information and program specific information for MPEG compatible processing.

BACKGROUND OF THE INVENTION

In video broadcast and processing applications, digital video data is typically encoded to conform to the requirements of a known standard. One such widely adopted standard is the MPEG2 (Moving Pictures Expert Group) image encoding standard, hereinafter referred to as the "MPEG standard". The MPEG standard is comprised of a system encoding section (ISO/IEC 13818-1, 10th Jun. 1994) and a video encoding section (ISO/IEC 13818-2, 20th Jan. 1995). Data encoded to the MPEG standard is in the form of a packetized datastream which typically includes the data content of many program channels (e.g. content corresponding to cable television channels 1–125). Further, several digital services and channels may occupy the frequency spectrum previously occupied by a single analog channel. A 6 MHz bandwidth previously allocated to an analog NTSC compatible broadcast channel may now be split into a number of digital sub-channels offering a variety of services. For example, the broadcast spectrum for RF channel 13 may be allocated to sub-channels including a main program channel, a financial service channel offering stock quotes, a sports news service channel and a shopping and interactive channel. In addition, both the quantity of sub-channels transmitted and the individual sub-channel bandwidth may be changed dynamically to accommodate changing broadcast programming requirements.

In such a digital video system the proliferation in the quantity of services being broadcast and the increased variety of their content, as well as the ability of a broadcaster to dynamically vary the number and allocated bandwidth of these channels poses a number of problems. Specifically, the increase in the quantity of broadcast channels may increase the difficulty of tuning and lengthen the time required to acquire a selected program channel. Further, as the quantity of channels increases so does the quantity of ancillary program specific information required in decoding the transmitted program data. The ancillary program specific information includes data used in identifying and assembling packets comprising selected programs and also includes program guide and text information associated with the transmitted program data. The increased quantity and variety of ancillary information transmitted places an additional burden on available transmission bandwidth and receiver decoding and storage resources.

In addition, channel numbering in such a digital video system may present a problem. This is because a broadcaster may not want to lose an original analog NTSC broadcast channel number even though the broadcaster is transmitting several program channels in the frequency spectrum previously occupied by the single analog program channel. The broadcaster may have a significant investment in the channel

number as a brand identity e.g. Fox 5™, Channel 13™. These problems and derivative problems are addressed by a system according to the present invention.

SUMMARY OF THE INVENTION

A decoder decodes packetized program information containing multiple text strings associated with a program. The decoder determines from a first indicator in the packetized program information a type of coding and compression employed in encoding a first text string. The decoder decodes the first text string with a decoding function selected in accordance with the determined type of coding and assembles decoded text string elements to form an output text string.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawing:

FIG. **1** is a block diagram of digital video receiving apparatus for demodulating and decoding broadcast signals, according to the principles of the invention.

FIG. **2** shows a Master Guide Table (MGT) format for use in conveying program specific information, according to the invention.

FIG. **3** shows a Channel Information Table (CIT) format for use in conveying program specific information incorporating dual program channel identification numbers, according to the invention.

FIG. **4** shows a Service Location Descriptor (SLD) format for use in conveying program specific information incorporating program map information, according to the invention.

FIG. **5** shows a program specific information text format for use in conveying program related text information, according to the invention.

FIG. **6** shows a scheme for assigning a text message identifier as used in the text format of FIG. **5**.

FIG. **7** shows a multiple compressed text string format for use in conveying program related text information, according to the invention.

FIGS. **8** and **9** show exemplary indicator definitions for compression and coding indicators within the multiple compressed text string format of FIG. **7**.

FIG. **10** shows a method for generating program specific information according to the invention.

DETAILED DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a digital video receiving system for demodulating and decoding broadcast signals, according to the principles of the invention. Although the disclosed system is described in the context of a system for receiving video signals incorporating program specific information including program guide data in MPEG compatible format, it is exemplary only. The program specific information may be of a variety of types. For example, it may comply with Program Specific Information (PSI) requirements specified in section 2.4.4 of the MPEG systems standard or it may comply with the high definition television (HDTV) signal standard *Digital Television Standard for HDTV Transmission* of Apr. 12 1995, prepared by the United States Advanced Television Systems Committee (ATSC) or other ATSC standards. Alternatively, it may be formed in accordance with proprietary or custom requirements of a particular system.

The principles of the invention may be applied to terrestrial, cable, satellite, Internet or computer network

broadcast systems in which the coding type or modulation format may be varied. Such systems may include, for example, non-MPEG compatible systems, involving other types of encoded datastreams and other methods of conveying program specific information. Further, although the disclosed system is described as processing broadcast programs, this is exemplary only. The term 'program' is used to represent any form of packetized data such as audio data, telephone messages, computer programs, Internet data or other communications, for example.

In overview, in the video receiver system of FIG. **1**, a broadcast carrier modulated with signals carrying audio, video and associated data representing broadcast program content is received by antenna **10** and processed by unit **13**. The resultant digital output signal is demodulated by demodulator **15**. The demodulated output from unit **15** is trellis decoded, mapped into byte length data segments, deinterleaved and Reed-Solomon error corrected by decoder **17**. The corrected output data from unit **17** is in the form of an MPEG compatible transport datastream containing program representative multiplexed audio, video and data components. The transport stream from unit **17** is demultiplexed into audio, video and data components by unit **22** which are further processed by the other elements of decoder system **100**. In one mode, decoder **100** provides MPEG decoded data for display and audio reproduction on units **50** and **55** respectively. In another mode, the transport stream from unit **17** is processed by decoder **100** to provide an MPEG compatible datastream for storage on storage medium **105** via storage device **90**.

A user selects for viewing either a TV channel or an on-screen menu, such as a program guide, by using a remote control unit **70**. Processor **60** uses the selection information provided from remote control unit **70** via interface **65** to appropriately configure the elements of FIG. **1** to receive a desired program channel for viewing. Processor **60** comprises processor **62** and controller **64**. Unit **62** processes (i.e. parses, collates and assembles) program specific information including program guide and system information and controller **64** performs the remaining control functions required in operating decoder **100**. Although the functions of unit **60** may be implemented as separate elements **62** and **64** as depicted in FIG. **1**, they may alternatively be implemented within a single processor. For example, the functions of units **62** and **64** may b e incorporated within the programmed instructions of a microprocessor. Processor **60** configures processor **13**, demodulator **15**, decoder **17** and decoder system **100** to demodulate and decode the input signal format and coding type. Units **13**, **15**, **17** and sub-units within decoder **100** are individually configured for the input signal type by processor **60** setting control register values within these elements using a bi-directional data and control signal bus C.

The transport stream provided to decoder **100** comprises data packets containing program channel data and program specific information. Unit **22** directs the program specific information packets to processor **60** which parses, collates and assembles this information into hierarchically arranged tables. Individual data packets comprising the User selected program channel are identified and assembled using the assembled program specific information. The program specific information contains conditional access, network information and identification and linking data enabling the system of FIG. **1** to tune to a desired channel and assemble data packets to form complete programs. The program specific information also contains ancillary program guide information (e.g. an Electronic Program Guide—EPG) and descriptive text related to the broadcast programs as well as data supporting the identification and assembly of this ancillary information.

The program specific information is assembled by processor **60** into multiple hierarchically arranged and interlinked tables. An exemplary hierarchical table arrangement includes a Master Guide Table (MGT), a Channel Information Table (CIT), Event Information Tables (EITs) and optional tables such as Extended Text Tables (ETTs). The MGT contains information for acquiring program specific information conveyed in other tables such as identifiers for identifying data packets associated with the other tables. The CIT contains information for tuning and navigation to receive a User selected program channel. The EIT contains descriptive lists of programs (events) receivable on the channels listed in the CIT. The ETT contains text messages describing programs and program channels. Additional program specific information describing and supplementing items within the hierarchical tables is conveyed within descriptor information elements. The program specific information acquired by processor **60** via unit **22** is stored within internal memory of unit **60**.

Considering FIG. **1** in detail, a carrier modulated with signals carrying program representative audio, video and associated data received by antenna **10**, is converted to digital form and processed by input processor **13**. Processor **13** includes radio frequency (RF) tuner and intermediate frequency (IF) mixer and amplification stages for down-converting the input signal to a lower frequency band suitable for further processing. In this exemplary system, the input signal received by antenna **10** contains 33 Physical Transmission Channels (PTCs **0**–**32**). Each Physical Transmission Channel (PTC) is allocated a 6 MHz bandwidth and contains, for example, up to 6 sub-channels.

It is assumed for exemplary purposes that a video receiver user selects a sub-channel (SC) for viewing using remote control unit **70**. Processor **60** uses the selection information provided from remote control unit **70** via interface **65** to appropriately configure the elements of decoder **100** to receive the PTC corresponding to the selected sub-channel SC. Following down conversion, the output signal from unit **13** for the selected PTC has a bandwidth of 6 MHz and a center frequency in the range of 119–405 MHz. In the following discussion, an RF channel or Physical Transmission Channel (PTC) refers to an allocated broadcaster transmission channel band which encompasses one or more sub-channels (also termed virtual or logical channels).

Processor **60** configures the radio frequency (RF) tuner and intermediate frequency (IF) mixer and amplification stages of unit **13** to receive the selected PTC. The down-converted frequency output for the selected PTC is demodulated by unit **15**. The primary functions of demodulator **15** are recovery and tracking of the carrier frequency, recovery of the transmitted data clock frequency, and recovery of the video data itself. Unit **15** also recovers sampling and synchronization clocks that correspond to transmitter clocks and are used for timing the operation of processor **13**, demodulator **15** and decoder **17**. The recovered output from unit **15** is provided to decoder **17**.

The output from demodulator **15** is mapped into byte length data segments, deinterleaved and Reed-Solomon error corrected according to known principles by unit **17**. In addition, unit **17** provides a Forward Error Correction (FEC) validity or lock indication to processor **60**. Reed-Solomon error correction is a known type of Forward Error Correction. The FEC lock indication signals that the Reed-Solomon

error correction is synchronized to the data being corrected and is providing a valid output. It is to be noted that the demodulator and decoder functions implemented by units **13**, **15** and **17** are individually known and generally described, for example, in the reference text *Digital Communication*, Lee and Messerschmidt (Kluwer Academic Press, Boston, Mass., USA, 1988).

The corrected output data from unit **17** is processed by MPEG compatible transport processor and demultiplexer **22**. The individual packets that comprise either particular program channel content, or program specific information, are identified by their Packet Identifiers (PIDs). Processor **22** separates data according to type based on an analysis of Packet Identifiers (PIDs) contained within packet header information and provides synchronization and error indication information used in subsequent video, audio and data decompression.

The corrected output data provided to processor **22** is in the form of a transport datastream containing program channel content and program specific information for many programs distributed through several sub-channels. The program specific information in this exemplary description describes sub-channels present in a transport stream of a particular PTC. However, in another embodiment the program specific information may also describe sub-channels located in other PTCs and conveyed in different transport streams. Groups of these sub-channels may be associated in that their source is a particular broadcaster or they occupy the transmission bandwidth previously allocated to an analog NTSC compatible broadcast channel. Further, individual packets that comprise a selected program channel in the transport stream are identified and assembled by processor **60** operating in conjunction with processor **22** using PIDs contained in the program specific information.

The program specific information is in the form of hierarchically arranged tables including an MGT, CIT, EIT, and ETT together with supplementary descriptor information. The PID that identifies packets comprising the MGT data is predetermined and stored within processor **60** internal memory. Further, the MGT conveys the PIDs that identify the CIT, EIT, and ETT data and conveys other information indicating the size of these tables. Processor **60** monitors the MGT for updates to identify any changes in PIDs or table sizes. Therefore, after processor **60** determines from the FEC lock indication provided by unit **17** that valid data is being provided to transport processor **22**, the MGT may be acquired without additional PID information. Using Control signal C, processor **60** configures transport processor **22** to select the data packets comprising the remaining program specific information including the CIT, EIT and ETT data. Processor **22** matches the PIDs of incoming packets provided by unit **17** with PID values pre-loaded in control registers within unit **22** by processor **60**. Further, processor **60** accesses, parses and assembles the program specific information packets captured by processor **22** and stores the program specific information within its internal memory. Processor **60** derives tuning parameters including PTC carrier frequency, demodulation characteristics, and sub-channel PIDs, from the acquired program specific information. Processor **60** uses this information in configuring units **13**, **15**, **17** and decoder **100** elements to acquire selected sub-channel (SC) program content.

The program specific information including MGT, CIT, EIT, and ETT data and associated descriptors acquired and collated by processor **60** incorporates advantageous features exemplified in the data formats presented in FIGS. **2**–**9**. These features facilitate the identification, acquisition, assembly and decoding of program channel content and associated program guide data by decoder **100** (FIG. **1**). Processor **60** forms a MGT as exemplified by the data format of FIG. **2** by accessing and assembling the program specific information packets that are stored in the unit **60** internal memory. The MGT contains data identifiers e.g. PID_ETT **205** and PID_PG **210** (FIG. **2**) enabling the assembly of the CIT, EIT and ETT tables. Processor **60** uses the MGT data identifiers to access and assemble the program specific information packets to form the CIT, EIT, and ETT data and associated descriptors.

Processor **60** uses the acquired CIT channel map information, as exemplified in FIG. **3**, to identify the packets comprising the sub-channel SC that the User selected to view. A user selects sub-channel SC for viewing by entering two program channel numbers via remote control unit **70** and interface **65**. Individual program channels are advantageously allocated both a first and a second identification number. The first identification number (a major number as indicated by bundle_number **300** in FIG. **3**) identifies the broadcast source and broadcaster channel brand number e.g. Fox 5™, Channel 13™. The first identification number indicates a broadcast source of a program or service and may be independent of the RF channel on which the program is broadcast. However, in other embodiments the first identification number may be associated with a broadcast RF channel or be associated with other program characteristics such as a program category or theme e.g. movies. The second identification number (a minor number as indicated by channel_number_in_bundle **305** in FIG. **3**) identifies a sub-channel corresponding to a specific service within a group of services provided by a broadcaster. The first and second identification numbers in conjunction identify a particular service as a sub-channel provided by a specific broadcaster. Although, the selected sub-channel SC may occupy an RF bandwidth within an encompassing channel spectrum associated with the broadcast source, neither the first or second identification numbers are associated with such a spectrum. However, this association may be made in an alternative embodiment. This dual numbering system enables a broadcaster to retain channel brand identity across a range of dynamically allocable broadcast sub-channels.

The dual program channel identification numbers used to select sub-channel SC may be entered by the user in a variety of ways. These may include using remote unit **70** to select sub-channel SC from within a hierarchical menu system displaying program channel selections in a program guide or by simple sequential number entry via the unit **70** keypad, for example. The channel selection system may also encompass the use of a different data entry device such as a keyboard or discrete switches, for example. Further, the data entry system also accommodates the entry of a single channel identification number as well as dual identification numbers. Upon detecting a channel selection completion command, processor **60** converts a single channel identification number entry into dual identification numbers. Processor **60** converts the single channel identification number to dual channel identification numbers in accordance with a predetermined conversion map. This conversion may also be performed using a predetermined and stored algorithm or formula. The derived dual identification numbers are used by processor **60** for packet identification, tuning and for identifying other decoder information in the manner previously described as if both numbers had been entered by a user.

Processor **60** uses the received program channel identification numbers **300** and **305** provided from remote control

unit **70** via interface **65** to determine the PTC corresponding to the selected sub-channel SC from the CIT. Once the PTC number (item **315** in FIG. **3**) is determined, processor **60** (FIG. **1**) configures units **13**, **15**, and **17** to receive the PTC for the selected sub-channel SC. The unique program sub-channel determined from the program channel identification numbers **300** and **305** may alternatively be termed a service or a virtual channel or a logical channel and the CIT may be deemed a virtual channel table. Further, as well as associating a particular PTC with first and second sub-channel identification numbers **300** and **305** of selected sub-channel SC, the CIT also associates other parameters with SC. These parameters include (a) a channel_id **320** for linking the selected sub-channel SC with program content information conveyed in the EITs, (b) a channel_type indicator **325** identifying whether the sub-channel data is, analog e.g. NTSC, digital video e.g. ATSC video or digital audio e.g. ATSC audio, (c) an ETM_flag **330** indicating whether a text message is available for this sub-channel, (d) a channel name **340** and (e) a descriptor **335** e.g. a Service Location Descriptor as described later.

Processor **60** advantageously determines program map information for the selected sub-channel SC from Service Location Descriptor (SLD) conveyed within the CIT. The SLD program map information is exemplified by the data format of FIG. **4**. The SLD associates the selected sub-channel SC with packet identifiers, e.g. item **420**, used to identify individual packetized datastreams that constitute the components of a program being transmitted on selected sub-channel SC. In addition, the SLD program map information, in conjunction with the CIT, maps the selected sub-channel SC to a program number **405**, a PCR (Program Clock Reference) identifier **410**, a language code indicator **425**, and a stream type identifier **415** identifying a stream as video, audio, control, auxiliary or private information, for example.

The SLD program map information replicates information already present within the Program Map Table (PMT) segment of the MPEG compatible transport stream input to decoder **100**. However, by incorporating the SLD within the CIT, the time required by decoder **100** to identify and acquire a program being transmitted on selected sub-channel SC is advantageously reduced. This is because the CIT and SLD provide formatted and linked information sufficient to enable processor **60** to directly configure and tune the system of FIG. **1** to receive the selected sub-channel SC. Specifically, the CIT and SLD directly associate individual first and second sub-channel identification numbers with the PIDs for identifying the datastreams that constitute a program being conveyed on this sub-channel. This enables processor **60** to configure the system of FIG. **1** to receive the selected sub-channel SC without acquiring and using the Program Map Table (PMT) information in the MPEG compatible transport stream input to decoder **100**. In addition, the data partitioning, data formatting and data repetition frequency characteristics of the CIT and SLD program map information m ay be determined independently of the requirements of MPEG PMT information.

The packetized decoded transport stream input to decoder **100** from unit **17** contains video, audio and data representing TV programs, for example, and also contains sub-picture data. The sub-picture data contains picture elements associated with programs and channels selectable by a user for viewing including program guides, display commands, subtitling, selectable menu options or other items, for example. As such, the sub-picture data includes the EIT containing descriptive lists of programs (events) receivable on the sub-channels listed in the CIT and also contains the ETT containing text messages describing programs and program sub-channels.

Processor **60** determines from the CIT and SLD the PIDs of the video, audio and sub-picture streams constituting the program being transmitted on selected sub-channel SC. Processor **22**, matches the PIDs of incoming packets provided by decoder **17** with PID values of the video, audio and sub-picture streams being transmitted on sub-channel SC. These PID values are pre-loaded in control registers within unit **22** by processor **60**. In this manner, processor **22** captures packets constituting the program transmitted on sub-channel SC and forms them into MPEG compatible video, audio and sub-picture streams for output to video decoder **25**, audio decoder **35** and sub-picture processor **30** respectively. The video and audio streams contain compressed video and audio data representing the selected sub-channel SC program content. The sub-picture data contains the EIT and ETT information associated with the sub-channel SC program content.

Decoder **25** decodes and decompresses the MPEG compatible packetized video data from unit **22** and provides decompressed program representative pixel data to NTSC encoder **45** via multiplexer **40**. Similarly, audio processor **35** decodes the packetized audio data from unit **22** and provides decoded and amplified audio data, synchronized with the associated decompressed video data, to device **55** for audio reproduction. Processor **30** decodes and decompresses sub-picture data received from unit **22**.

The sub-picture data decoded by processor **30** includes text messages (Extended Text Messages—ETMs) in an ETT in the exemplary data format presented in FIG. **5**. The text messages conveyed in the ETT of FIG. **5** are advantageously partitioned into time periods of specified duration. The segmented text messages describe programs occurring in a period of specified duration and start time e.g. 3 hour blocks starting from 12 a.m., 3 p.m., 6 p.m. . . . etc. Indicators defining the duration and start time applicable to the conveyed text messages are included in the MGT of FIG. **2** (duration item **215** and application_time item **220** of FIG. **2** respectively). A text message (e.g. extended_text_message **505**) is conveyed together with a text message identifier (ETM_id **510**) in the format of FIG. **5**.

Decoder **100** (FIG. **1**) is able to more efficiently acquire, process and store program descriptive text messages that are partitioned into time periods of specified duration than is possible in the absence of such segmentation. This is because segmented text messages exclude information occurring outside the specified time period and consequently are smaller than non-segmented text messages. Therefore, segmented text message data occupies less storage space and can be acquired and processed more quickly than larger data blocks of non-segmented data. Further, the data format of FIG. **5** allows a user to acquire text message data for a selected sub-channel SC or a group of selected program sub-channels. This allows the identification, acquisition and decoding of text message data by decoder **100** to be focused on the programs and sub-channels of interest to a user and reduces the acquisition of redundant text message information.

A text message conveyed in an ETT may contain channel information or program (event) information. FIG. **6** shows an exemplary format for assigning a text message identifier ETM_id **510** of FIG. **5** that identifies the type of text message e.g. whether the text message contains channel information (item **610** of FIG. **6**) or program information

(item **605** of FIG. **6**). The text message identifier **510** (FIG. **5**) also identifies the source e.g. sub-channel to which the text message pertains.

A text message **505** conveyed in the ETT of FIG. **5** is compressed and formatted according to the multiple compressed text string format of FIG. **7**. The compressed text string format advantageously incorporates indicators facilitating the identification and decoding of multiple compressed text strings by processor **30** in decoder **100** of FIG. **1**. Processor **30** decodes text string **505** (FIG. **5**) received from unit **22** (FIG. **1**) by determining the compression, coding and language characteristics of the text string from indicators **705**, **710** and **715** (FIG. **7**) respectively. Specifically, processor **30**, operating in conjunction with processor **60**, decompresses received text string **505** by applying a decompression function e.g. a Huffman decompression function, selected using indicator **705**. Similarly, processor **30**, decodes the received text string by applying a decoding function interpreting text characters according to a character code set selected using indicator **710** and a language code set selected using indicator **715**. Further, processor **30** determines the number of text strings to be processed and the number of bytes in each text string from indicators **725** and **720** respectively.

FIG. **8** shows an exemplary indicator definition for compression indicator **705** within the multiple compressed text string format of FIG. **7**. It is to be noted that compression indicator **705** may indicate that no compression function is employed within a text string. In this case, processor **30** does not apply a decompression function to the text string received from unit **22**. FIG. **9** shows an exemplary indicator definition for coding indicator **710** within the multiple compressed text string format of FIG. **7**.

Processor **30** assembles and formats the decoded and decompressed text string elements of text string **505** (FIG. **5**) to form a decoded text string for output to On-Screen Display (OSD) and graphics generator **37** (FIG. **1**). Unit **37** interprets and formats the text string character data from unit **30** and generates formatted pixel mapped text and graphics for presentation on unit **50**. The formatted pixel mapped text and graphics data may represent a program guide or other type of menu or user interface for subsequent display on unit **50**. Unit **37** also processes EIT, ETT and other information to generate pixel mapped data representing, subtitling, control and information menu displays including selectable menu options, and other items, for presentation on unit **50**. The control and information displays enable function selection and entry of device operating parameters for User operation of decoder **100**.

The text and graphics produced by OSD generator **37** are generated in the form of overlay pixel map data under direction of processor **60**. The overlay pixel map data from unit **37** is combined and synchronized with the decompressed pixel representative data from MPEG decoder **25** in encoder **45** via multiplexer **40** under direction of processor **60**. Combined pixel map data representing a video program on sub-channel SC together with associated sub-picture text message data is encoded by NTSC encoder **45** and output to device **50** for display.

In a storage mode of the system of FIG. **1**, the corrected output data from unit **17** is processed by decoder **100** to provide an MPEG compatible datastream for storage. In this mode, a program is selected for storage by a user via remote unit **70** and interface **65**. Processor **22**, in conjunction with processor **60** forms condensed program specific information including MGT, CIT, EIT and ETT data and descriptors containing the advantageous features previously described. The condensed program specific information supports decoding of the program selected for storage but excludes unrelated information. Processor **60**, in conjunction with processor **22** forms a composite MPEG compatible datastream containing packetized content data of the selected program and associated condensed program specific information. The composite datastream is output to storage interface **95**.

Storage interface **95** buffers the composite datastream to reduce gaps and bit rate variation in the data. The resultant buffered data is processed by storage device **90** to be suitable for storage on medium **105**. Storage device **90** encodes the buffered datastream from interface **95** using known error encoding techniques such as channel coding, interleaving and Reed Solomon encoding to produce an encoded datastream suitable for storage. Unit **90** stores the resultant encoded datastream incorporating the condensed program specific information on medium **105**.

FIG. **10** shows a method for generating program specific information including MGT, CIT, EIT and ETT data and descriptors containing the advantageous features previously described. The method may be employed at an encoder for broadcasting video data such as the data received by antenna **10** of FIG. **1** or the method may be employed within a decoder unit such as within processor **60** of FIG. **1**.

Following the start at step **800** of FIG. **10**, a CIT is generated in step **810**. The CIT contains sub-channel and program identification information enabling acquisition of available broadcast programs and sub-channels. The CIT incorporates first and second sub-channel identification numbers and an SLD containing packet identifiers for identifying individual packetized datastreams that constitute individual programs to be transmitted on particular sub-channels. The generated CIT also incorporates items linked to listed program sub-channels including a program number, a PCR (Program Clock Reference) identifier, a language code indicator, and a stream type identifier, as previously described in connection with FIG. **1**.

In step **815**, an EIT is generated containing program guide information including descriptive lists of programs (events) receivable on the sub-channels listed in the CIT. In step **820**, an ETT is generated containing text messages describing programs, for example. Each text message is partitioned into time periods of specified duration. The duration and application time of the segmented text message data is also defined by indicators in the ETT itself. The text message data is encoded and compressed according to known techniques and conveyed in the ETT along with indicators defining the compression, coding and language characteristics employed. The ETT is also generated to include indicators defining the number of text strings to be processed and the number of bytes in each text string. In step **822** an MGT is generated containing data identifiers enabling the identification and assembly of CIT, EIT and ETT information. The MGT also conveys table size information for the previously generated CIT, EIT and ETT.

In step **825**, program specific information is formed including the MGT, CIT, EIT and ETT data and descriptors generated in steps **805–822**. In step **830**, the program specific information together with video and audio program representative components for multiple sub-channels is formatted into a transport stream for output. In step **835**, the output transport stream is further processed to be suitable for transmission to another device such as a receiver, video server, or storage device for recording on a storage medium,

for example. The processes performed in step **835** include known encoding functions such as data compression Reed-Solomon encoding, interleaving, scrambling, trellis encoding, and carrier modulation. The process is complete and terminates at step **840**. In the process of FIG. **10**, multiple CIT, EIT and ETT tables may be formed and incorporated in the program specific information in order to accommodate expanded numbers of sub-channels.

The architecture of FIG. **1** is not exclusive. Other architectures may be derived in accordance with the principles of the invention to accomplish the same objectives. Further, the functions of the elements of decoder **100** of FIG. **1** and the process steps of FIG. **10** may be implemented in whole or in part within the programmed instructions of a microprocessor. In addition, the principles of the invention apply to any form of MPEG or non-MPEG compatible electronic program guide. A datastream formed according to the invention principles may b e used in a variety of applications including video server or PC type communication via telephone lines, for example. A program datastream with one or more components of video, audio and data formed to incorporate program specific information according to invention principles may be recorded on a storage medium and transmitted or re-broadcast to other servers, PCs or receivers. Further, any reference herein to "bandwidth" is to be interpreted expansively to include bit rate capacity and is not limited to a frequency spectrum, for example.

What is claimed is:

1. Apparatus for decoding packetized program information containing multiple text strings associated with a program, comprising:

means for determining from a first indicator in said packetized program information a type of coding and compression employed in encoding a first text string;

means for decoding said first text string with a decoding function selected in accordance with said determined type of coding; and

means for assembling decoded text string elements to form an output text string.

2. Apparatus according to claim **1**, wherein

said means for decoding comprises means for decompressing said first text string with a decompression function selected in accordance with said type of compression.

3. Apparatus according to claim **1**, wherein

said first indicator indicates that no compression function is used in encoding said first text string, and

said means for decoding comprises means for interpreting codes in said first text string to produce text characters.

4. Apparatus according to claim **1**, including

means for determining from a second indicator in said packetized program information a language type used in said first text string.

5. Apparatus according to claim **4**, including

means for decoding said decoded first text string with a decoding function selected in accordance with said determined language type.

6. Apparatus according to claim **1**, including

means for determining from a second indicator in said packetized program information the number of text strings to be decoded.

7. Apparatus according to claim **1**, including

means for determining from a text mode coding indicator in said packetized program information a type of character interpretation to be used in interpreting decoded text.

8. Apparatus according to claim **1**, including

means for determining from a second indicator in said packetized program information the number of text bytes in a text string to be decoded.

9. Apparatus according to claim **1**, wherein

said decoded text string represents at least one of a) program or channel descriptive information, b) a broadcast channel name, c) geographical region information, d) program content rating information, e) program or channel map table information, f) program or event table description information, and g) geographical rating region table information.

10. A storage medium containing MPEG compatible digital data representing video information comprising:

a packetized video program; and

information containing,

(a) multiple text strings associated with said packetized video program,

(b) a first indicator for indicating a type of coding employed in encoding a first text string, said first indicator being suitable for use in selecting a decompression function to be used in decoding said first text string; and

(c) information suitable for use in assembling decoded text string elements to form an output text string.

11. A storage medium according to claim **10**, wherein

said first indicator also indicates that no decompression function is to be used in decoding said first text string.

12. Apparatus for generating program specific information suitable for inclusion in packetized video program information, said program specific information including multiple text strings associated with a video program, said apparatus comprising:

means for forming text string decoding information for decoding multiple text strings, said decoding information including,

(a) a first indicator indicating a type of compression employed in encoding a first text string for selecting a decoding function to be used in decoding said first text string; and

(b) information suitable for assembling decoded text string elements to form a decoded text string; and

means for incorporating said text string decoding information into program specific information for output.

13. Apparatus according to claim **12**, wherein

said first indicator indicates that no decompression function is to be used in decoding said first text string.

14. Apparatus according to claim **12**, wherein said text string decoding information includes

a language type indicator indicating a language used in said first text string.

15. Apparatus according to claim **12**, wherein said text string decoding information includes

a second indicator indicating a number of text strings to be decoded.

16. Apparatus according to claim **12**, wherein said text string decoding information includes

a text mode coding indicator indicating a type of character interpretation to be used in interpreting decoded text.

17. Apparatus according to claim **12**, wherein said text string decoding information includes

a second indicator indicating a number of text bytes in a text string to be decoded.

18. Apparatus according to claim **12**, wherein

said first text string represents at least one of a) program or channel descriptive information, b) a broadcast

channel name, c) geographical region information, d) program content rating information, e) program or channel map table information, f) program or event table description information, and g) geographical rating region table information.

19. A method for decoding packetized video program information containing multiple text strings associated with a program, comprising the steps of:

determining from a first indicator in said packetized video program information a type of coding employed in encoding a first text string;

decompressing said first text string with a decompression function selected in accordance with said determined type of compression; and

assembling decoded text string elements to form an output text string.

20. A method for generating program specific information suitable for inclusion in packetized video program information, said program specific information including multiple text strings associated with a video program, said method comprising the steps of:

forming text string decoding information for decoding multiple text strings, said information including,

(a) a first indicator indicating a type of compression employed in encoding a first text string for selecting a decompression function to be used in decoding said first text string; and

(b) information suitable for use in assembling decoded text string elements to form a decoded text string; and

incorporating said text string decoding information into program specific information for output.

* * * * *

US005374951A

United States Patent [19]

Welsh

[11] **Patent Number:** **5,374,951**

[45] **Date of Patent:** **Dec. 20, 1994**

[54] **METHOD AND SYSTEM FOR MONITORING TELEVISION VIEWING**

[75] Inventor: **Russell J. Welsh**, Toronto, Canada

[73] Assignee: **PEACH Media Research, Inc.**, Toronto, Canada

[21] Appl. No.: **89,672**

[22] Filed: **Jul. 8, 1993**

Related U.S. Application Data

[63] Continuation of Ser. No. 532,030, Jun. 1, 1990, abandoned.

[51] **Int. Cl.**[5] **H04N 7/10**

[52] **U.S. Cl.** **348/4**; 455/2; 455/6.3; 379/92

[58] **Field of Search** 455/2, 3.1, 4.1, 4.2, 455/5.1, 6.1, 6.2, 6.3; 380/10; 358/84, 85, 86; 348/4, 12; 379/92

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Primary Examiner—Reinhard J. Eisenzopf
Assistant Examiner—Andrew Faile
Attorney, Agent, or Firm—Faegre & Benson

[57] **ABSTRACT**

A system for monitoring and recording as data television program viewing habits utilizing a plurality of remote program monitor units in panelists households and automatically periodically reporting such data to a central computer via a conventional telephone network.

18 Claims, 11 Drawing Sheets

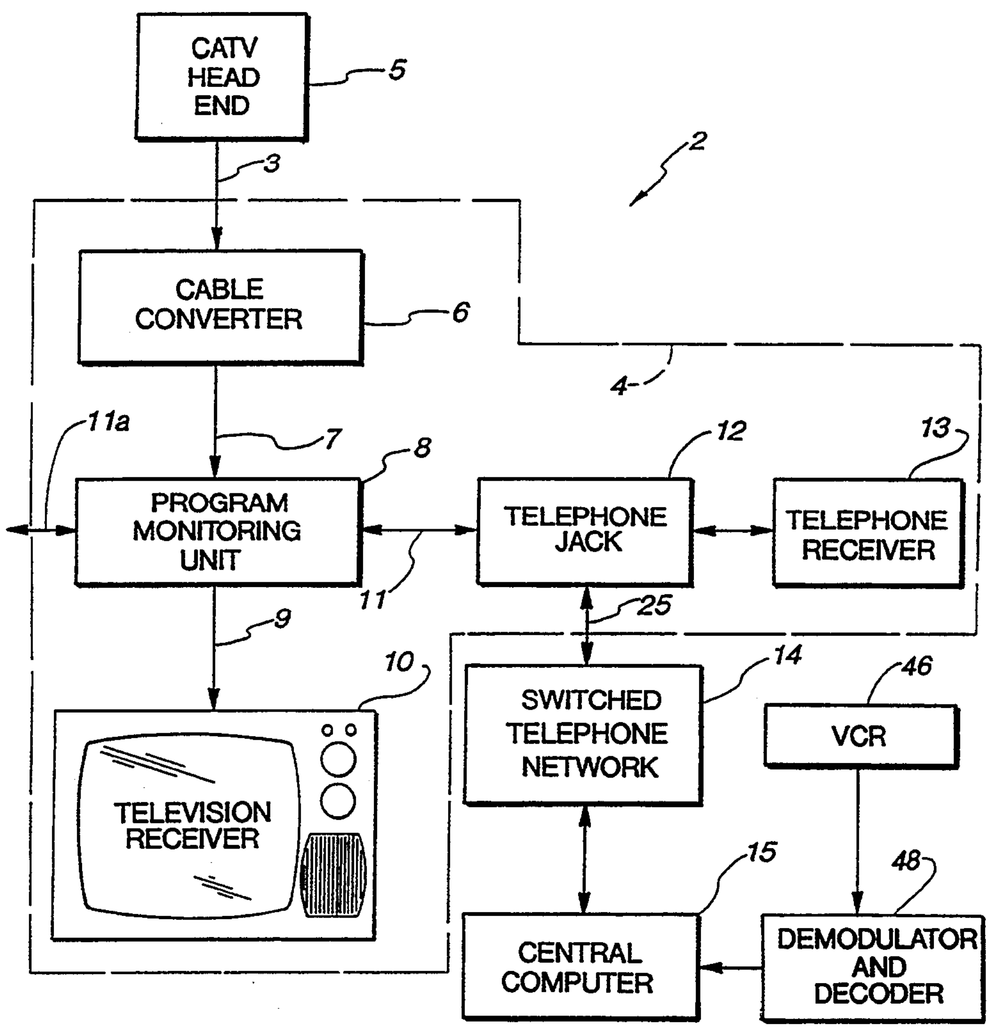


Fig. 1

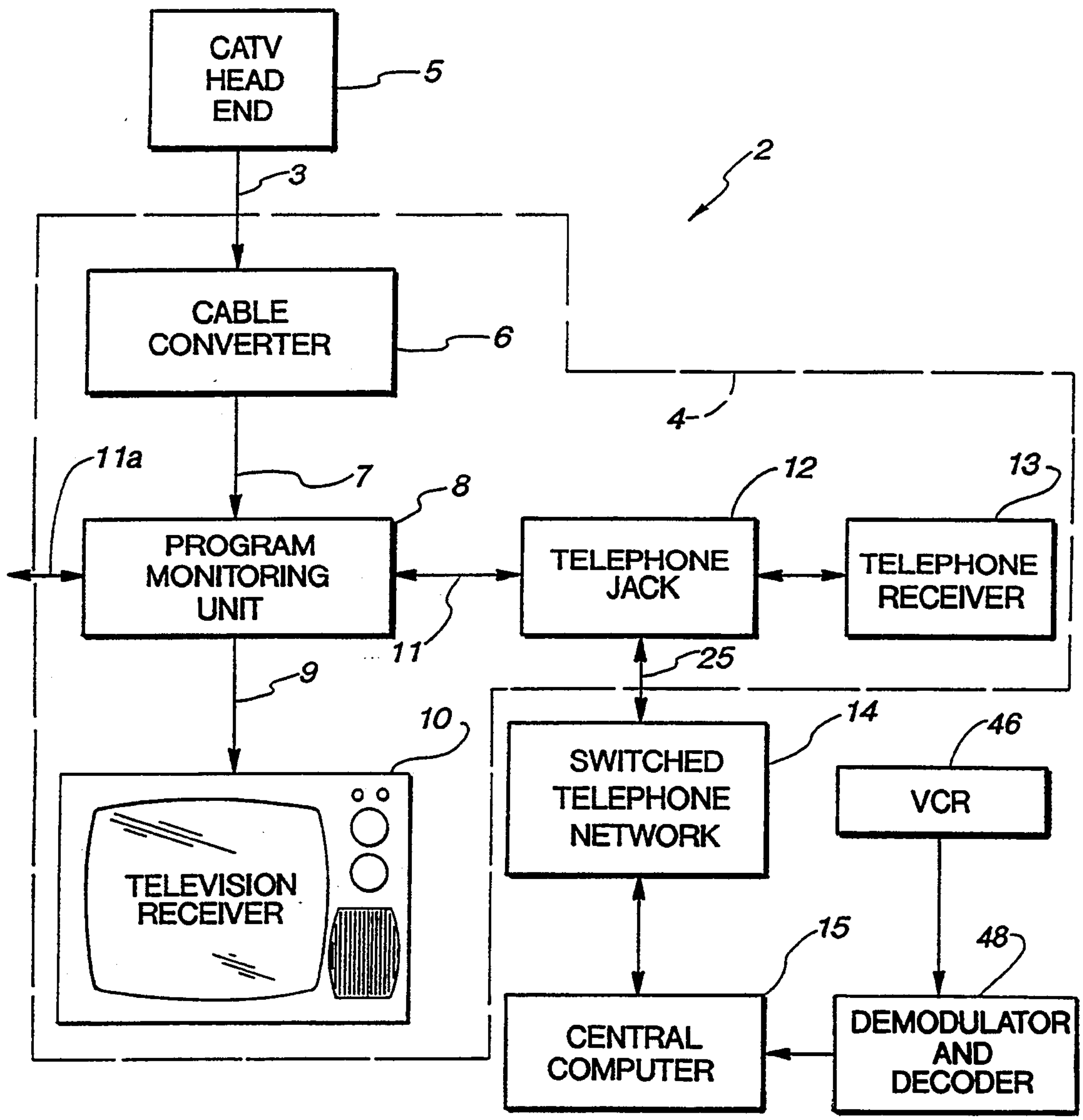

CATV
HEAD
END
5
2
3
CABLE
CONVERTER
6
4
11a
7
8
12
13
PROGRAM
MONITORING
UNIT
TELEPHONE
JACK
TELEPHONE
RECEIVER
11
9
25
10
14
46
SWITCHED
TELEPHONE
NETWORK
VCR
TELEVISION
RECEIVER
15
48
CENTRAL
COMPUTER
DEMODULATOR
AND
DECODER

Fig. 1a

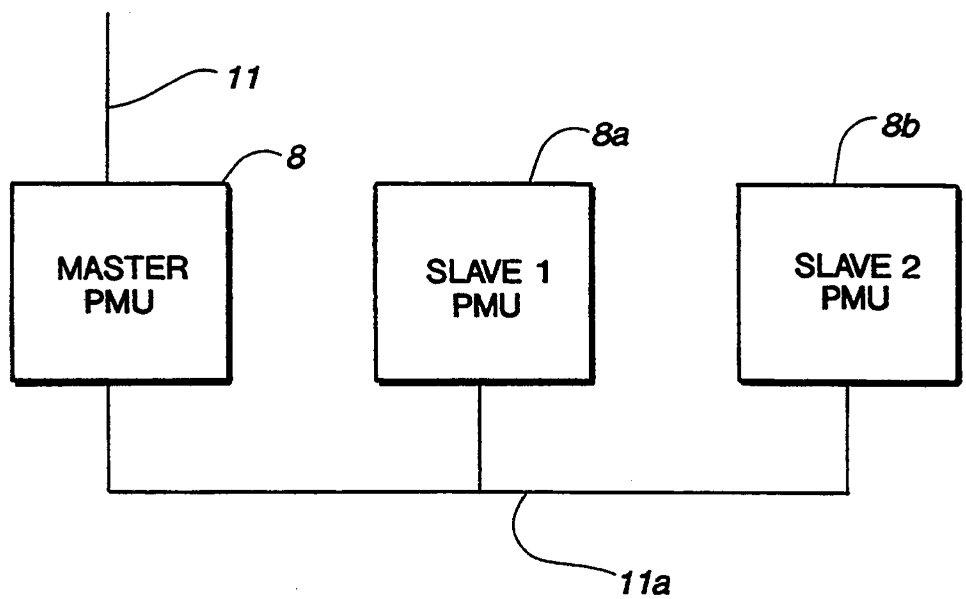
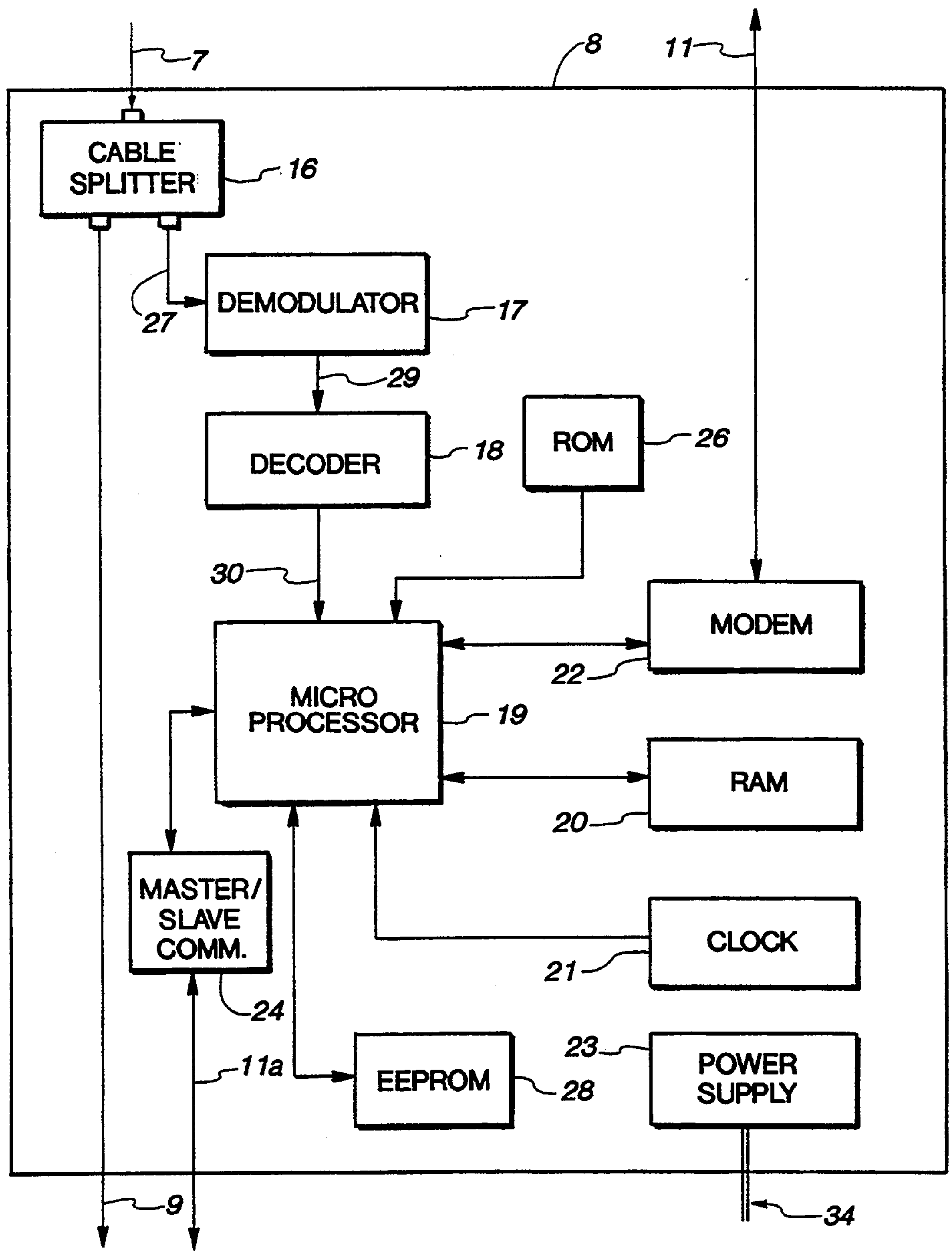


Fig. 2



7
8
11
CABLE SPLITTER
16
DEMODULATOR
17
27
29
DECODER
18
ROM
26
30
MODEM
22
MICRO PROCESSOR
19
RAM
20
MASTER/ SLAVE COMM.
CLOCK
21
24
23
EEPROM
11a
28
POWER SUPPLY
9
34

Fig. 2a

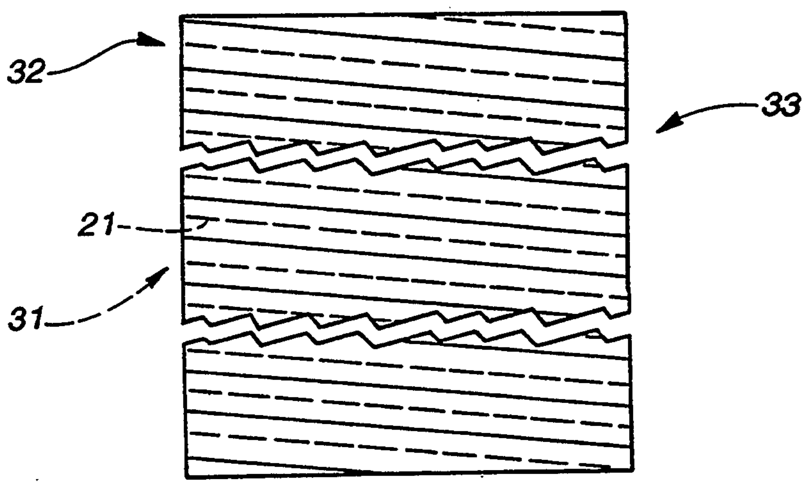
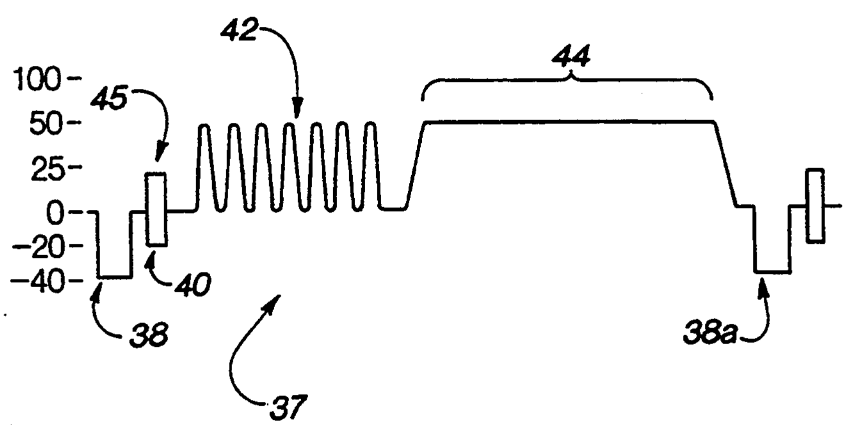


Fig. 2b



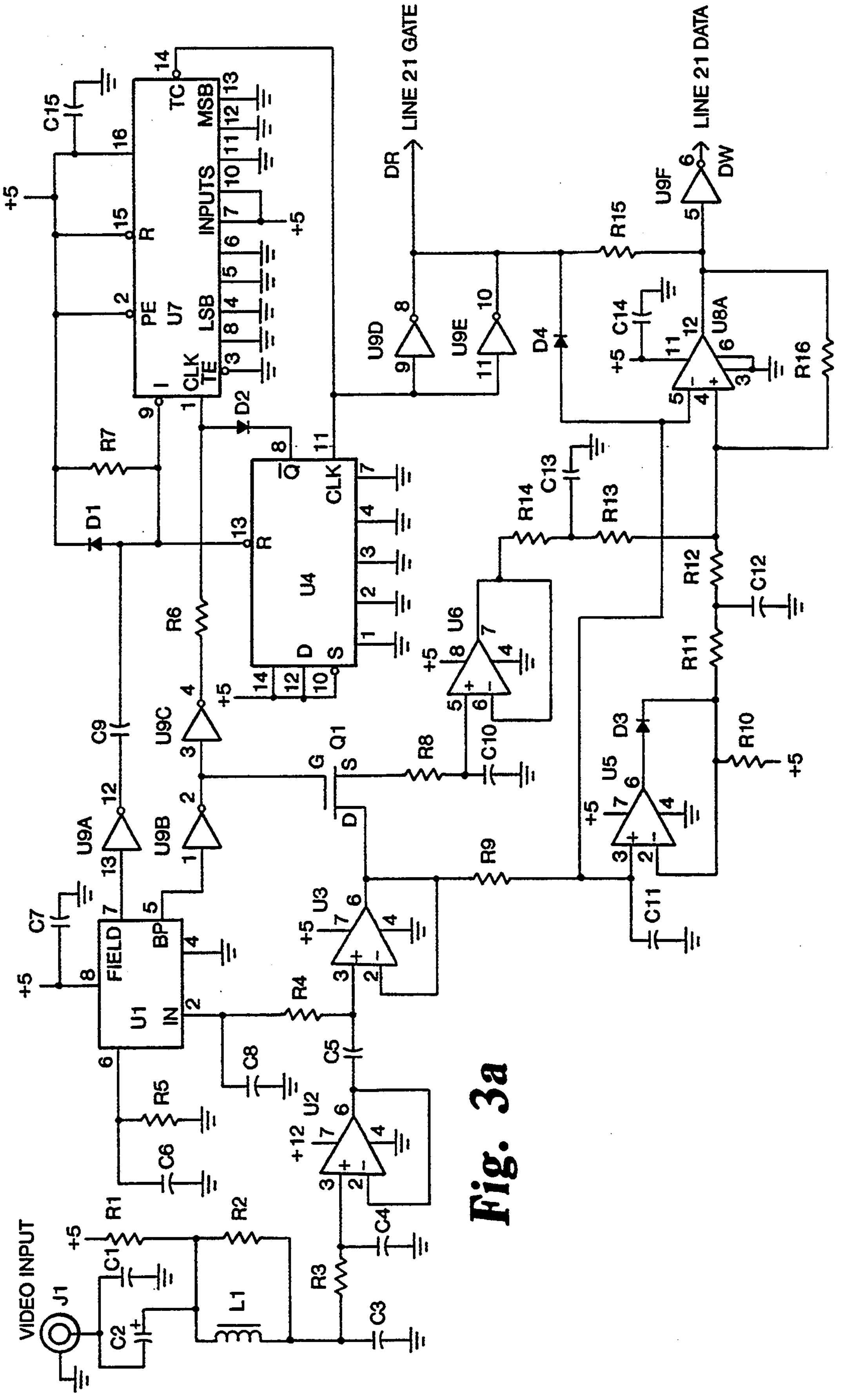


Fig. 3a

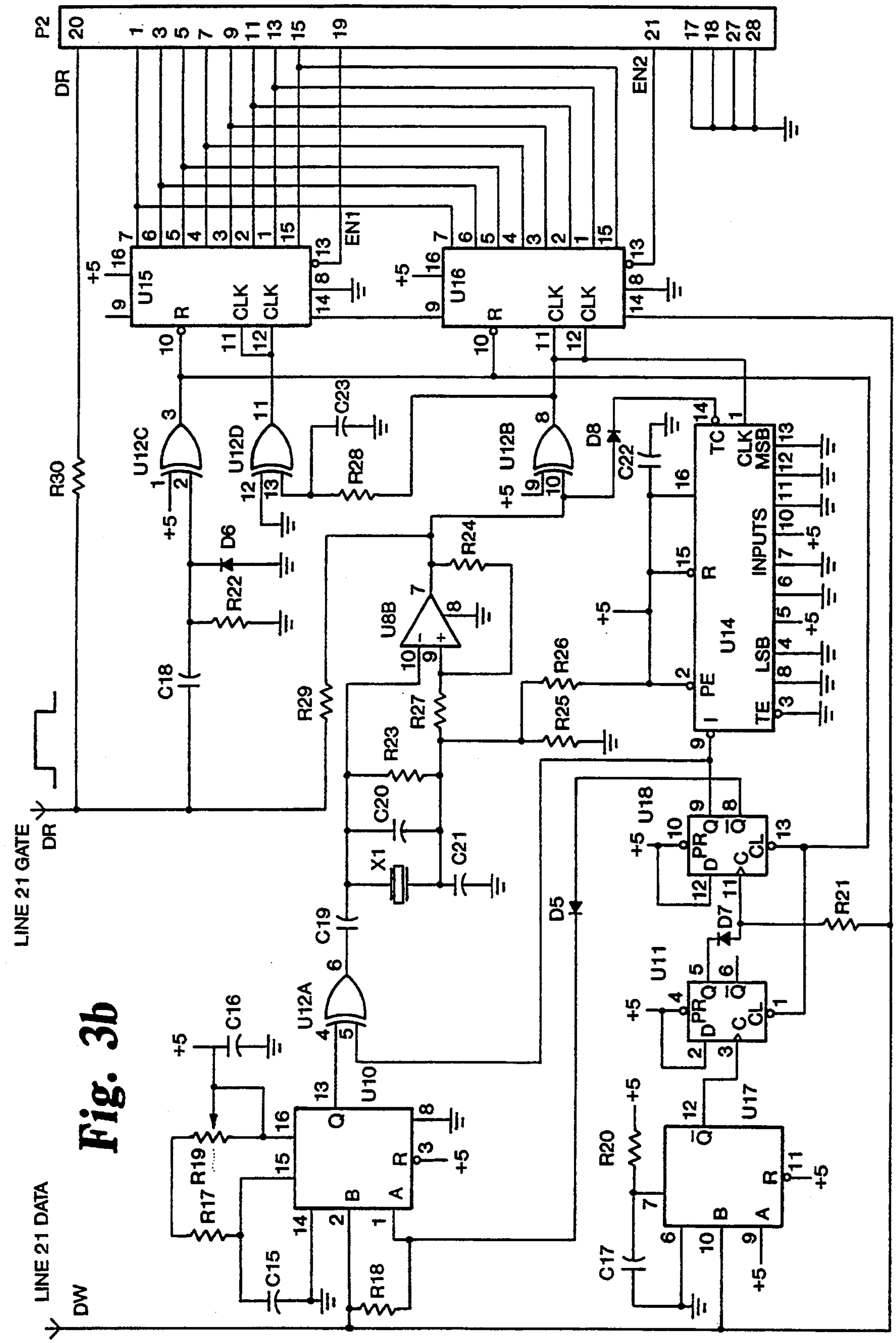

P2
DR
EN2
EN1
LINE 21 GATE
DR
LINE 21 DATA
DW
U15
U16
U14
U12A
U12B
U12C
U12D
U8B
U10
U11
U17
U18
INPUTS
MSB
LSB
X1

Fig. 3b

Fig. 4

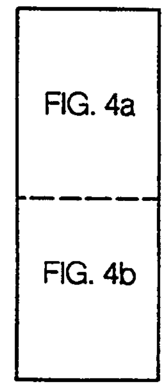
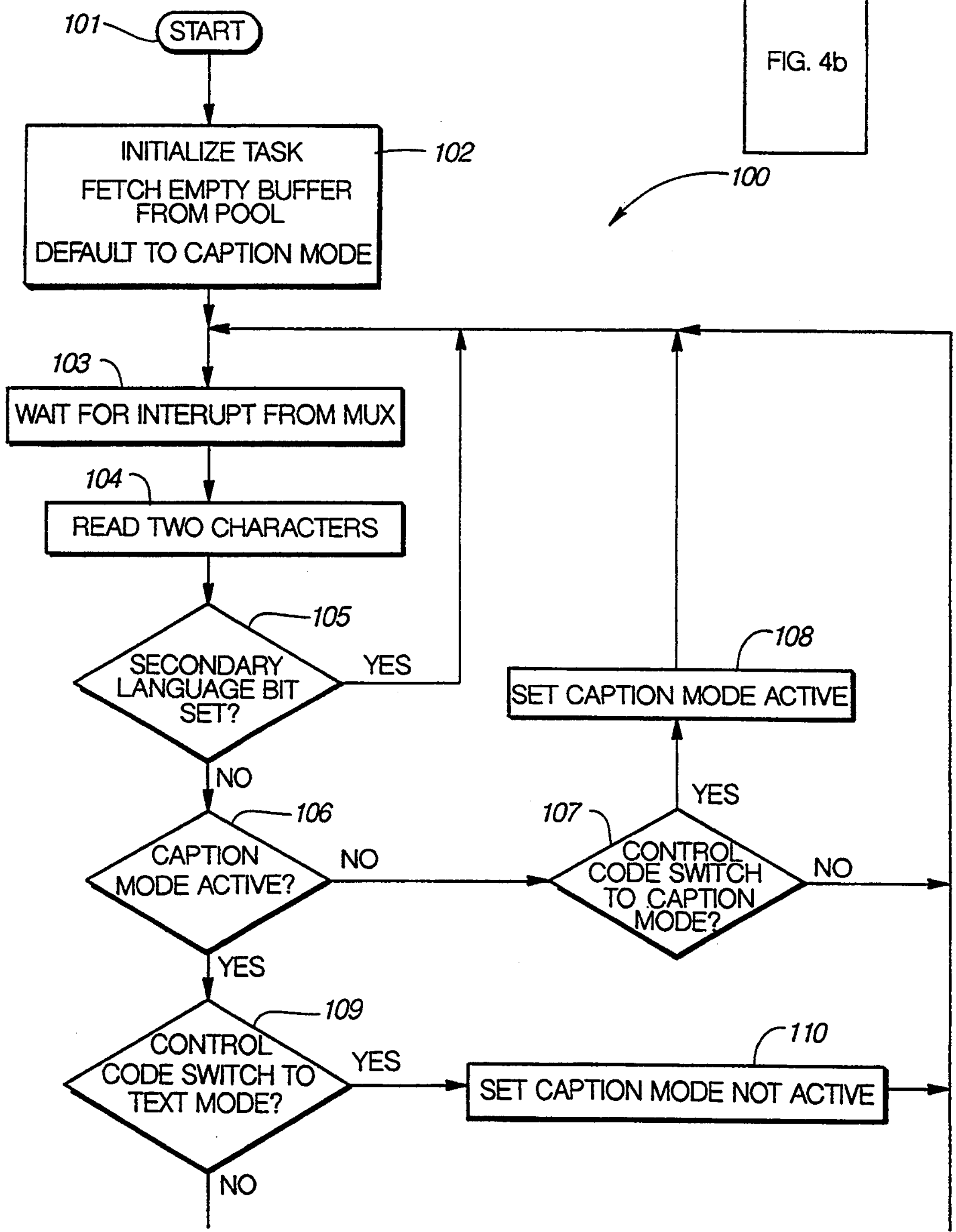


FIG. 4a
FIG. 4b
100

Fig. 4a


101
START
102
INITIALIZE TASK
FETCH EMPTY BUFFER FROM POOL
DEFAULT TO CAPTION MODE
103
WAIT FOR INTERUPT FROM MUX
104
READ TWO CHARACTERS
105
SECONDARY LANGUAGE BIT SET?
YES
NO
106
CAPTION MODE ACTIVE?
NO
YES
107
CONTROL CODE SWITCH TO CAPTION MODE?
YES
NO
108
SET CAPTION MODE ACTIVE
109
CONTROL CODE SWITCH TO TEXT MODE?
YES
NO
110
SET CAPTION MODE NOT ACTIVE

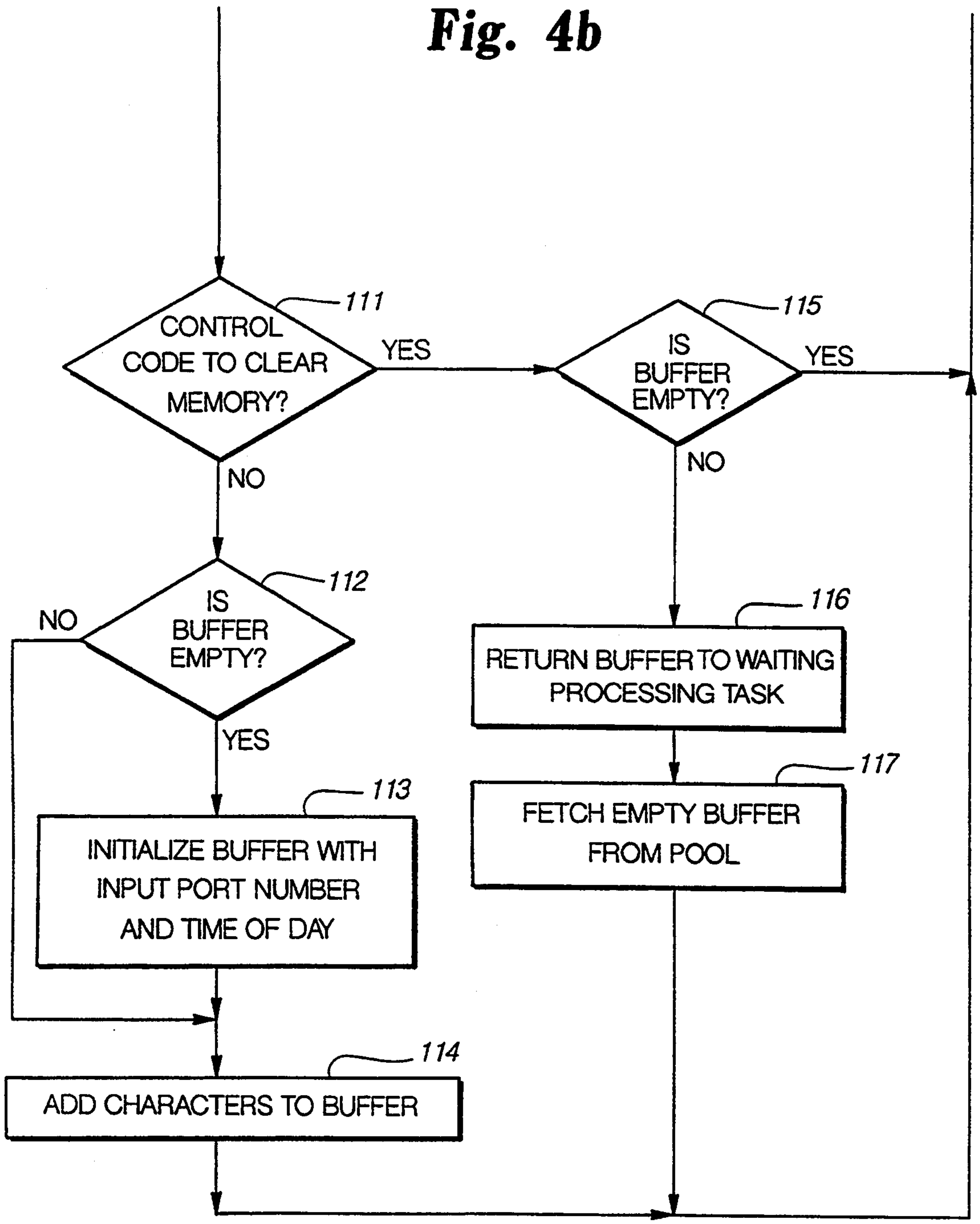


Fig. 4b
CONTROL CODE TO CLEAR MEMORY?
111
YES
NO
IS BUFFER EMPTY?
115
YES
NO
IS BUFFER EMPTY?
112
NO
YES
INITIALIZE BUFFER WITH INPUT PORT NUMBER AND TIME OF DAY
113
ADD CHARACTERS TO BUFFER
114
RETURN BUFFER TO WAITING PROCESSING TASK
116
FETCH EMPTY BUFFER FROM POOL
117

Fig. 5

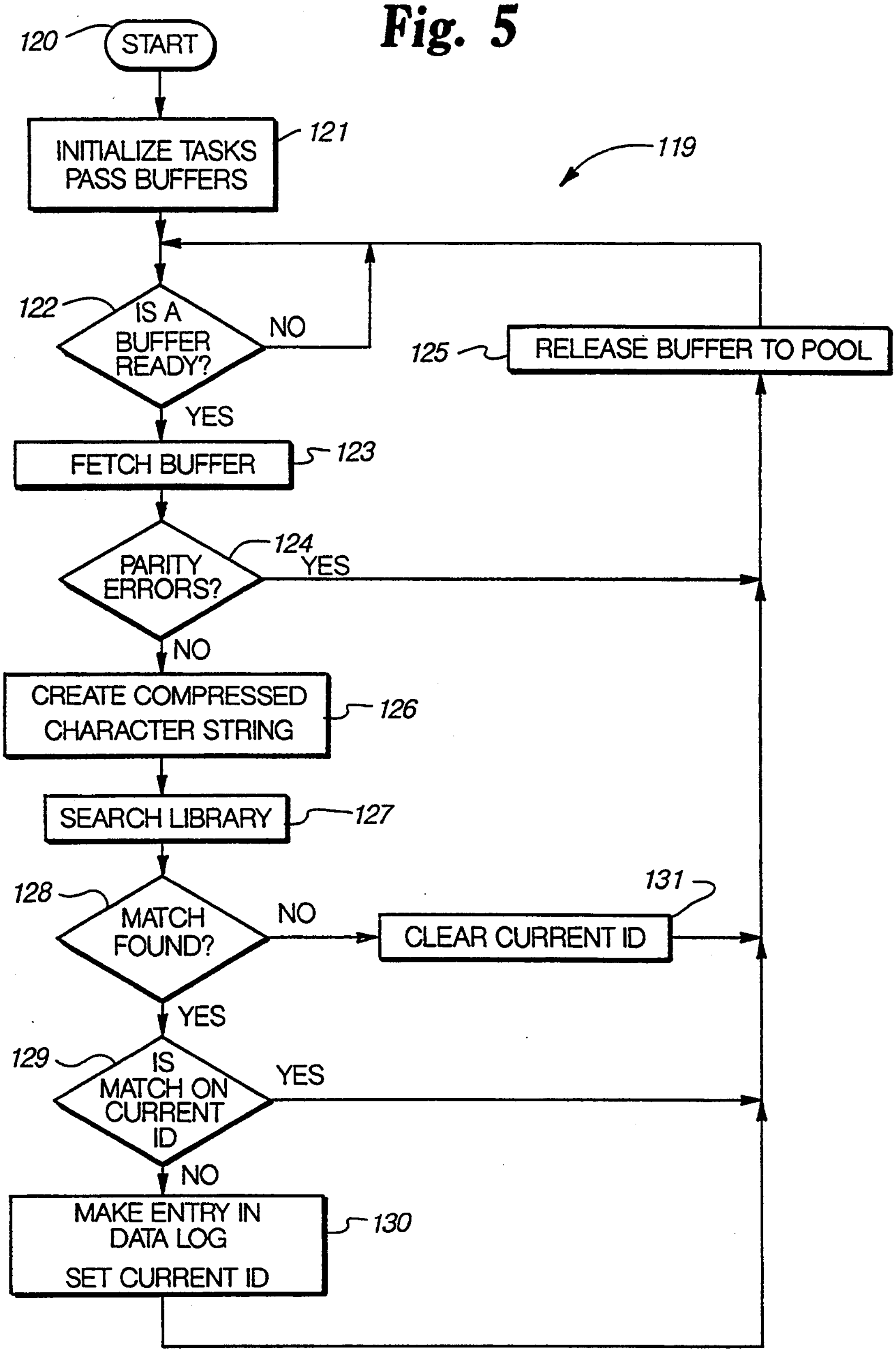
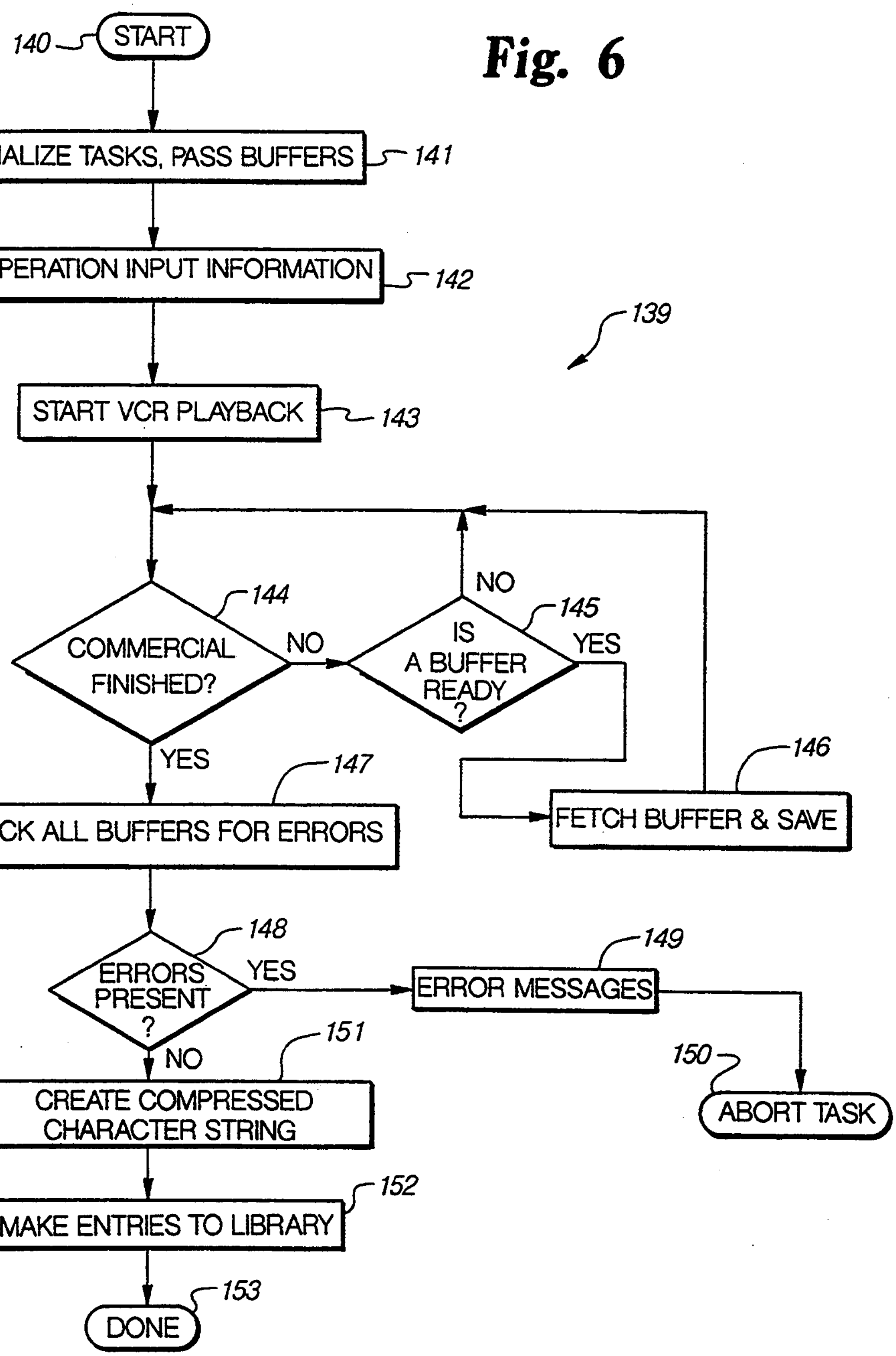
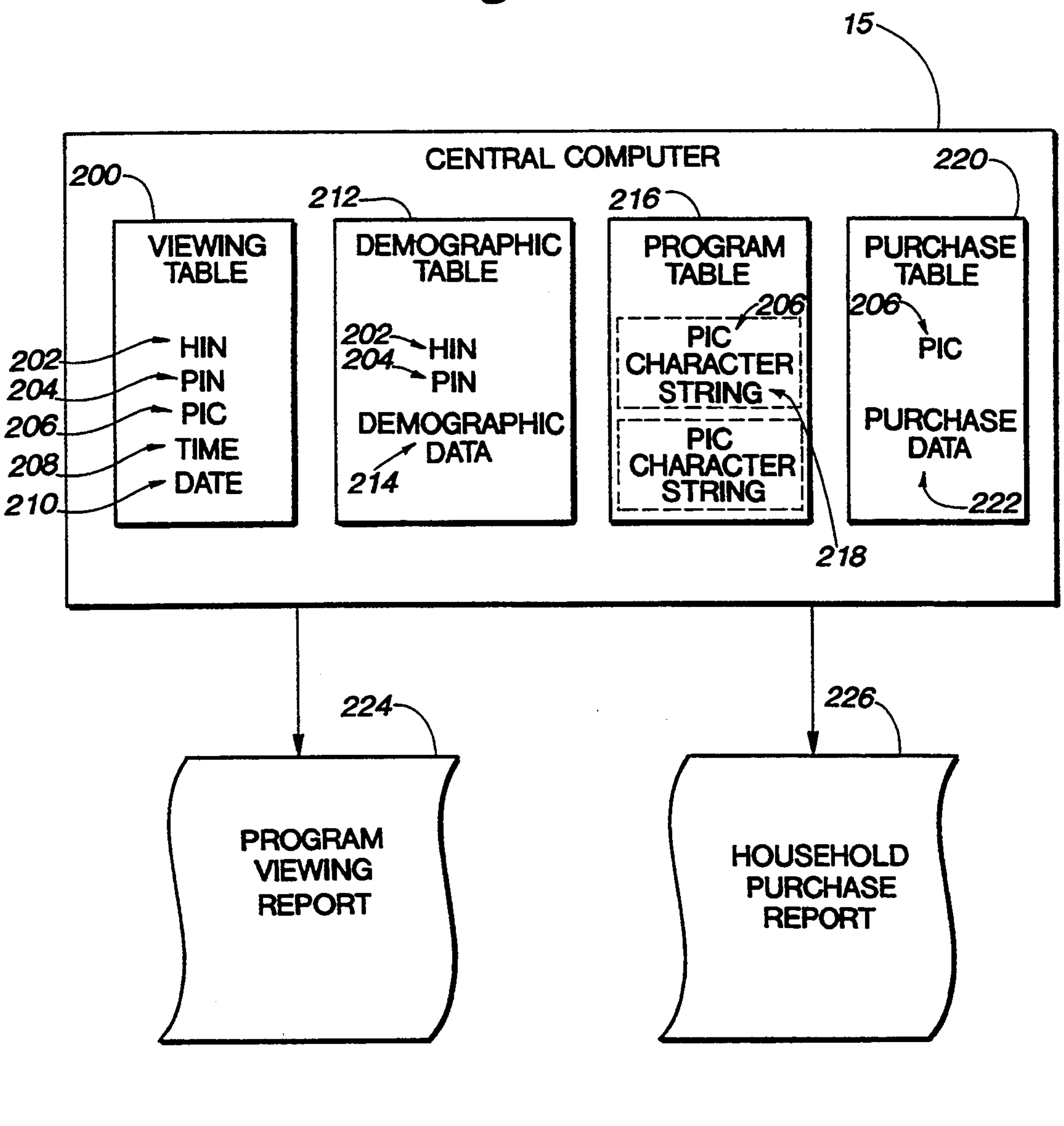

120
START
INITIALIZE TASKS
PASS BUFFERS
121
119
122
IS A BUFFER READY?
NO
YES
125
RELEASE BUFFER TO POOL
FETCH BUFFER
123
124
PARITY ERRORS?
YES
NO
CREATE COMPRESSED CHARACTER STRING
126
SEARCH LIBRARY
127
128
MATCH FOUND?
NO
131
CLEAR CURRENT ID
YES
129
IS MATCH ON CURRENT ID
YES
NO
MAKE ENTRY IN DATA LOG
SET CURRENT ID
130

Fig. 6



140
START
INITIALIZE TASKS, PASS BUFFERS
141
OPERATION INPUT INFORMATION
142
139
START VCR PLAYBACK
143
144
COMMERCIAL FINISHED?
NO
IS A BUFFER READY ?
145
NO
YES
YES
146
FETCH BUFFER & SAVE
147
CHECK ALL BUFFERS FOR ERRORS
148
ERRORS PRESENT ?
YES
ERROR MESSAGES
149
NO
151
CREATE COMPRESSED CHARACTER STRING
150
ABORT TASK
MAKE ENTRIES TO LIBRARY
152
DONE
153

Fig. 7


15
CENTRAL COMPUTER
200
VIEWING TABLE
202
HIN
204
PIN
206
PIC
208
TIME
210
DATE
212
DEMOGRAPHIC TABLE
202
HIN
204
PIN
DEMOGRAPHIC DATA
214
216
PROGRAM TABLE
206
PIC CHARACTER STRING
PIC CHARACTER STRING
218
220
PURCHASE TABLE
206
PIC
PURCHASE DATA
222
224
PROGRAM VIEWING REPORT
226
HOUSEHOLD PURCHASE REPORT

METHOD AND SYSTEM FOR MONITORING TELEVISION VIEWING

This is a continuation of copending application Ser. No. 07/532,030 filed on Jun. 1, 1990, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates generally to an improved method and apparatus for identifying television broadcast programs as they are received by a television receiver in the household. This invention is particularly useful in the field of test marketing but is not limited thereto. Test marketing allows businesses to test and experiment with a marketing strategy in a limited geographic area before committing to a full launch of the proposed marketing plan. Test markets are usually conducted by monitoring the behavior of a panel of households in a limited geographical area. Very precise demographic information is maintained on the households in the panel. The research generally consists of monitoring the behavior of a panel of households both before and after one or more variables in the environment have been changed. The research also consists of correlating the panelists' behavior with exposure to television commercials and other forms of advertisement. An example of one type of relationship that is of particular interest to the researcher is the relationship between the purchasing behavior of panelists and viewing of television commercials by panelists. Two types of data are required to study this relationship. First is the data related to the panelists' behavior, such as their purchasing patterns of products or services. The second type of data that is monitored is the number of exposures to a particular commercial or advertisement that the panelists receive. Sometimes the researcher monitors two or more panels of households at the same time. This technique permits inter group comparisons to be made as each group is exposed to either different types of commercials or advertisements and/or different amounts of exposure to these stimuli. The groups may be referred to as the control group and the test group.

DESCRIPTION OF THE PRIOR ART

Collection of the data relating to the products purchased by the cooperating panelists can be done by one of several well known methods, some of which are described in some of the prior art. One such method utilized in the past has been to have the cooperating panelists manually maintain a diary of their purchases. Another method as described in U.S. Pat. No. 4,331,973 issued May 25, 1982 to Eskin et al. for a Panelist Response Scanning System requires the cooperation of retailers in the test area. Panelists who present their unique identification card to the cashier at the point of purchase will automatically have their purchases recorded. The purchases are recorded in stores where universal product code automated check-outs are available and the collected information is retained in the store's computer and transferred to the market research firm's database at a convenient time. Another system as set forth in U.S. Pat. No. 4,658,290 issued on Apr. 14, 1987, to McKenna et al. permits the panelists to record their purchases in the house through the use of a universal product code reader. The information collected can be stored in a collection unit in the house and subsequently transferred to a central location.

Several different methods exist, when conducting a test market in a limited geographic area, to select those households that will be exposed to a special television signal and to monitor the number of exposures to the signal. To expose only those selected panelists to the special television signal, such as a commercial, the signal is inserted into regular programming and transmitted to selected households.

An old technique used in test marketing is described in U.S. Pat. No. 3,366,731, issued Jan. 30, 1968 to Edward Wallerstein for Television Distribution System Permitting Program Substitution for Selected Viewers. In this system two cables originating from the same source go out to different groups of households. With this system configuration different advertisements can be inserted on each cable and transmitted to the different groups. A shortcoming of this system is that there is no automatic recording of the event when the television is tuned to a channel on which an advertisement has been sent out. To get an estimate of the panelists exposure to the substituted commercial the researcher must rely on program ratings and audience projections for the program during which the substitute commercial was transmitted.

Another approach to market research is illustrated in U.S. Pat. No. 3,639,686, issued Feb. 1, 1972 to Harold R. Walker and Ira Kamen for Television Receiver Cut-In Device. In this system an auxiliary television signal is broadcast throughout a broadcast area with a particular control signal identifying the class of viewers that is to be reached by the auxiliary television signal. This system uses special decoders which tune to the special signal under certain conditions when the receiver receives a particular address signal identifying the respective receivers as being in the class to which the signal is to be transmitted. A limitation of the system is that it does not record the event as to whether or not the special television signal was displayed on the television.

An improvement on the previous two systems is illustrated in U.S. Pat. No. 4,331,974, issued May 25, 1982 to Cogswell et al. for Cable Television With Controlled Signal Substitution and U.S. Pat. No. 4,331,973, issued May 25, 1982 to Eskin et al. These patents describe a dynamic cut in device, so called because the household panels may be individually selected for each market test conducted by the researchers. A major problem with these sophisticated methods is that at least one additional channel is required to transmit the substitute television signal. With the proliferation of new cable channels, spare channels are scarce, difficult to obtain and therefore expensive. The necessity for this extra channel in some of the prior art increases the total cost of conducting the test market as the extra channel has to be leased from the cable operator. Another problem is that although the system does record when a panelist television receiver is turned on and the channel selected by the respective viewer, this vast quantity of information must be mapped onto a master schedule or some other similar procedure must be performed to determine if the substitute program was displayed on the panelist's television receiver.

Yet another system is described in U.S. Pat. No. 4,658,290 issued to McKenna et al. describes a household data gathering system that utilizes a simplex receiver which permits dynamic allocation so that television signal substitution may be performed. Similar to most of the other systems described, this one also requires the alternate signal to be transmitted from the

cable head end and down channels normally not used for entertainment.

SUMMARY OF THE INVENTION

One object of the present invention is to provide a novel automatic method and apparatus for identifying broadcast television programs and commercials as they are viewed by selected households.

Another object of the present invention is to provide an improved in-house commercial monitoring system so that when it is combined with a split cable system and any of the known techniques for collecting product purchase data, it provides a new and improved cost efficient means of conducting test marketing.

Another object of the present invention is to provide an improved method of commercial monitoring that may be incorporated into any of the known methods of signal substitution and reduce the amount of data that previously needed to be collected.

These and other objects are achieved by monitoring in the panelist's household the programs and commercials on the channel to which the viewer is tuned. One method of monitoring using a central computer system is described in U.S. Pat. No. 4,857,999 issued Aug. 15, 1989, for a Video Monitoring System and assigned to the assignee of the present invention.

The method of the present invention similarly monitors line **21** of field **1** of the television signal to extract strings of characters. These character strings are compared to a library of preselected character strings which are stored in a memory located in a remote panelist's household unit after having been transmitted from a central location to the unit via the non-dedicated telephone line. If a match of character strings is obtained, the occurrence of the event and the time it occurred are logged in the unit's memory. This data may be transmitted at an appropriate time to a central location via a non-dedicated telephone line.

The present invention is superior to the existing techniques used in panelists households as it will be able to identify a plurality of predetermined commercials as they are viewed in the house and record the occurrence of such events. This is an improvement over the prior art as it eliminates the need to monitor the channels and times at which the commercials were broadcast on the cable so that the commercials viewed by panelists can be determined from the television set tuning data that is collected in the house. A further improvement over the prior art is that the present invention reduces the amount of information that must be stored by the monitoring unit located in the panelist's house. This improvement is of particular use but not limited to an area of research known as "share of voice." In this type of research the advertiser is interested in comparing the number of exposures a panelist has received of a particular advertisement relative to exposures to other advertisements for similar products or services. The present invention is appropriate for this task as it can record when and which one of a plurality of preselected advertisements was viewed by the panelist. Unlike the prior art the present invention can record the occurrence of preselected events and there is no need for the researcher to monitor all channels to identify on what channel and at what time one of the commercials of interest occurred. This was necessary in prior art systems which only record whether the television receiver was on and to what channel it was tuned.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of the system.

FIG. **1***a* is a block diagram of a master-slave PMU subsystem.

FIG. **2** is a block diagram of the Program Monitoring Unit (PMU).

FIG. **2***a* is a diagram showing a view of fields **31**, **32** of frame **3**.

FIG. **2***b* shows the waveform of line **21**, field **31** of the NTSC television signal.

FIGS. **3***a* and **3***b* comprise a circuit diagram for the decoder shown as a block in FIG. **2**.

FIG. **4** is a key diagram for FIGS. **4***a* and **4***b*.

FIG. **4***a* is a partial flow chart for the software that assembles a paragraph of closed captioning data.

FIG. **4***b* is the continuation of FIG. **4***a*.

FIG. **5** is a flow chart for the software that seeks a match for a paragraph of received caption data in the caption library.

FIG. **6** is a flow chart for the steps required to make an entry to the caption library.

FIG. **7** is a block diagram of tables contained in and reports generated by the central computer of the system.

DETAILED DESCRIPTION

FIG. **1** shows a block diagram illustrating a program monitoring unit **8** interconnected with other components in a cable television based test market system **2** which includes commercial substitution. Preferably, a plurality of units **8** are provided, appropriately located in the houses of panelists or the like who have agreed to participate in the panel. The television signal emanates from a cable television head end **5** and is transmitted to a subscriber via a conventional transmission line **3**. The signal is directed to a cable converter **6** which is used by the householder to select the television channel that is to be viewed on a television receiver or set **10**. The output **7** of the cable converter **6** is normally fixed on one VHF television channel such as channel three. Output **7** of the cable converter **6** is connected to the program monitoring unit **8** where signal processing and data collection functions are performed, as explained in more detail later. The channel three signal on line **7** is preferably passed through the program monitoring unit **8** so that it can be viewed on the panelist's television set **10** via line **9**. A second output path or telephone line **11** from the program monitoring unit **8** is connected to a conventional telephone jack **12** through which outgoing and incoming telephone calls are linked to the panelist's house with appropriate wiring and the like interconnecting telephone receivers **13** in the panelist's house with a conventional switched telephone network **14**. A household telephone line **25** is used to provide a communication channel from the program monitoring unit **8** through network **14** to a central computer **15**. Boundary **4** encloses those elements of system **2** in a particular household and indicates elements to be replicated for multi-household applications.

Referring also now to FIG. **2**, the program monitoring unit or PMU **8** contains a character string table stored in a memory **20**. Each entry in this table consists of a character string and a shorter unique program identification code. The program monitoring unit **8** processes the television signal on line **7** to extract character strings that are embedded in the the television signal and then searches the character string table for a match.

When the program monitoring unit is first installed in a household, the table is initialized with the character strings and program identification codes for the commercials that it will search for. Whenever the program monitoring unit communicates with the central site, the contents of this table can be changed.

In accordance with this embodiment, memory **20** also store data as to which commercials have been viewed by the panelist. Periodically the program monitoring unit **8** will use the household telephone line **25** to "dial-up" the central computer **15**. On establishing appropriate telephone communications with the panelist's program monitoring unit **8**, the stored data is transmitted via the public switched telephone network **14** to the central computer **15**. In addition to extracting data from the program monitoring unit **8** while the telephone communication is active, the central computer **15** may also download instructions and data to the program monitoring unit **8** via the telephone line **25**.

The main components of the program monitoring unit (PMU) **8** preferably includes an 8-bit microprocessor **19**, ROM (read only memory) **26**, an EEPROM (electrically erasable programmable read only memory) **28**, a demodulator **17**, a decoder **18** and a power supply **23**. The power supply **23** provides the required power for various components to function properly, and is connected through a transformer (not shown) to the household's regular AC power source through lines **34**. Since each PMU **8** is unique to a particular house it contains an EEPROM **28** which is a non-volatile memory that is used to store parameters that are specific to the household. The information programmed into the EEPROM **28** includes a unique household identification number and the telephone numbers for the PMU **8** to use to "dial-up" the central computer **15**.

The PMU also contains a signal splitter **16** to which the signal from the household's cable converter **6** is directed. There are two output paths from the splitter **16**; the first path **9** goes directly to the television receiver **10** in the household so that the viewer watches the television channel that was originally selected on the cable converter **6**. Unlike some previous systems the present invention utilizes a conventional cable converter **6** that is normally found in households. The second output **27** of the splitter **16** is directed to demodulator **17**. The demodulated signal on line **29** is then sent to the decoder **18**. Decoder **18** produces the character strings that are encoded in the television signal. A preferred method used to decode the character string from the demodulated television signal is described in U.S. Pat. No. 4,857,999.

The character string is directed to the microprocessor **19** via path **30**. Microprocessor **19** compares this character string to strings contained in a character string table in the random access memory (RAM) **20**. If a match of character strings is detected, the present time on a system clock **41** and a program identification code for the commercial are stored in an event log in the RAM **20**. If no match is found the system ignores the decoded character string and no new data is stored in the event log. Each time a character string is produced by the decoder **18**, the previously described comparison procedure takes place.

PMU **8** also preferably includes a modem **22** by which it communicates with the central computer **15** via the regular telephone lines **25**. Each PMU **8** is assigned a time at which it uses the household telephone line to establish a connection with the central computer **15**. During a communication session with the PMU **8**, the central computer **15** may recover any data that has been collected by the PMU **8** and may update the character string table in RAM **20**.

The central computer **15** recovers the contents of the event log from a PMU **8** during a communication session. Each event recovered from a household PMU **8** includes the program identification code and corresponding date and time values. The central computer **15** maintains a database that includes household identification numbers and the program identification numbers for each commercial that each household viewed along with the corresponding date and time at which that respective commercial was viewed.

The description of system **2** to this point has described a situation in which only one television set is monitored in a household. However, it is to be understood that the system can easily be expanded to deal with households with more than one television set. In such event, each additional television set is equipped with a program monitoring unit **8**. At installation time, the EEPROM **28** in each unit would be programmed with a television set identification number unique to that household as well as the household identification number. During a communication session with each unit **8**, the central computer would recover the household and television set identification numbers as well as the contents of the data event logs.

An alternative method of handling multi-set houses uses one master unit to handle all communications with the central computer **15** and slave units to handle the data collection at each television set and which are able to communicate with the master unit.

To provide for this feature the PMU has a Master/-Slave Communication block **24** to facilitate the connection of the master unit to a plurality of slave units.

FIG. 1*a* shows a block diagram of a master PMU **8** connected to two slave PMUs **8*a*** and **8*b***. Each slave PMU **8*a*, *b*** is basically the same as the master PMU **8**, the only difference being that the slave PMUs **8*a*,*b*** need not contain a modem to facilitate communication with the central computer **15** via the telephone line **11**. The slave PMUs **8*a*, *b*** communicate with the central computer **15** through line **11*a*** to the master PMU **8** and then through the telephone line **11** connected to the modem **22** in the master PMU **8**. The master and slave units **8–8*a*,*b*** preferably communicate over dedicated wiring **11*a*** in the panelist's household that is installed at the same time as the PUMs **8–8*a*,*b***. Whenever the central computer communicates with the household it does so through the master PMU **8**. Any information sent to the master PMU **8** to update the character string table is automatically forwarded from the master unit **8** to the slave units **8*a*,*b***. Periodically the master unit **8** interrogates each of the slave units to collect any event log data that is present. The data from each of the slave units **8*a*, *b*** is maintained in separate memory areas in the master unit RAM **20**. When the central computer **15** communicates with the master unit **8** it will collect the data event logs of the slave units **8*a*,*b*** along with the event log of the master unit **8**.

The description to this point has described a system **2** in which the remote PMU **8** in the household has searched for specific character strings, each associated with a specific television commercial. However, in a more general application, the system could be used to identify all the commercials or all the programs including commercials that are viewed in the household. In

this case, the PMU **8** would store all the character strings that were decoded from the received television signal. These character strings would be returned to the central computer **15** during a normal communication session. The central computer would then assign the appropriate program identification codes.

Before proceeding with the description, some background on the closed captioning signal is required. The reader is directed to the referenced PBS Report No. E-7709-C for a complete specification of the closed captioning signal. The NTSC television signal is comprised of 30 picture frames per second with 525 scan lines per frame. Referring now to FIG. 2*a*, first and second fields **31, 32** of a frame **33** may be seen. Scan line **21** in field **31** of frame **33** is reserved for the closed captioning signal as described in the FCC Rules and Regulations Title 47, Part 73, Section 682. The waveform of this signal **37** is shown in FIG. 2*b* as depicted in the FCC Rules and Regulations Title 47, Part 73, Section 699 which is hereby expressly incorporated by reference herein. As depicted in FIG. 2*b*, line **21** consists of a horizontal sync pulse **38**, followed by the color burst **40**, followed by 7 cycles of clock run-in **42** and then a two-character wide data window **44** for closed captioning information. Data may be transmitted in the window as a pair of characters every 33.3 milliseconds. The maximum data rate is 60 characters per second.

The purpose of the decoder **18** is to process the composite video signal and extract the data in the window **44** which may include up to two characters of closed captioning information from each occurrence of line **21**. This module contains two sections—the first extracts line **21** signal or waveform **37** from field **31** of each frame **33** of the composite video signal and the second extracts character data from each occurrence of line **21** if characters are present in data window **44**.

The circuitry of the signal processing module **48** is shown in FIGS. 3*a* and 3*b*. FIG. 3*a* shows the circuit that extracts signal **37** from line **21**, field **31** of frame **33** and FIG. 3*b* shows the circuit that extracts characters from data window **44** of signal **37**.

The function of the circuitry shown in FIG. 3*a* is to process the composite NTSC television signal, separate the line **21** signal **37** from the complete NTSC signal and convert it into two digital signals, DR and DW. Signal DR is a line **21** gate signal and signal DW is a line **21** data signal.

The video is input at the connector **J1**. The video signal passes across a 1.8 nf capacitor **C1** and through a 22 uF capacitor **C2** to a 45 microhenry inductor **L1** in a resistive ladder network having a 100K resistor **R1** and a 1K resistor **R2**. The signal is then passed across a 3.3 nF capacitor **C3** and through a 1K resistor **R3** to a 100 pF capacitor **C4** and into the non-inverting input pin **3** of a type SE5534 operational amplifier **U2**, available from Signetics. Amplifier **U2** is connected in a unity gain non-inverting configuration having an output at pin **6** feeding a 0.1 uF capacitor **C5** which passes the AC component of this signal to the non-inverting input of another type SE5534 operational amplifier **U3**, also connected as a unity gain non-inverting follower. Output pin **6** of **U3** is connected to the drain D of a 2N7000 FET transistor **Q1**. The signal at pin **3** of **U3** is also connected through a 470 ohm resistor **R4**, across a 1.8 nF capacitor **C8** and into pin **2** of an LM1881 type integrated circuit, available from National Semiconductor. **U1** is used as a sync separator to identify the start of a new field. **U1** has field index and back porch gate outputs at pins **7** and **5**, respectively. **U1** further has a 0.1 uF capacitor **C6** and a 470K resistor **R5** connected to pin **6**. **U1** still further has a 0.1 uF noise suppression capacitor **C7** connected to its power supply input pin **8**. The FIELD output of **U1** at pin **7** is connected to a digital logic inverter **U9A**, which is preferably formed from a type 74HC04 hex inverter. The output of inverter **U9A** is passed through a 330 pF capacitor **C9** to input pin **9** of **U7**, which is a HC40103 type integrated circuit counter available from Signetics. Diode **D1**, along with all other diodes in FIGS. 3*a* and 3*b* may be a 1N4148 type. Output pin **5** from **U1** is connected to the input of another inverter **U9B**. Output pin **2** of inverter **U9B** is connected to the gate G of **Q1** and input pin **3** of inverter **U9C**. Output pin **4** of inverter **U9C** is connected through a 2K2 resistor **R6** to the clock input pin **1** of **U7** and through a diode **D2** to the not Q output pin **8** of **U4**. **U4** is preferably a type HC74 integrated circuit available from Signetics. A 3K3 resistor **R7** is connected from the power supply to the input pin **9** of **U7**.

The source S of **Q1** is connected through a 1K resistor **R8** to the non-inverting input pin **5** of a type LM358 integrated circuit operational amplifier, available from National Semiconductor. A 0.1 uF capacitor **C10** is connected between the non-inverting input pin **5** and circuit common. The output pin **7** of **U6** is connected through a resistive network of a 470 ohm resistor **R14** and a 12K resistor **R13** shunted by a 0.1 uF capacitor **C13** and passing to the non-inverting input pin **4** of **U8A**, which is preferably a type LM319 voltage comparator. Output pin **6** of **U3** is also connected through a 1K resistor **R9** and across a 100 pF capacitor **C11** to the non-inverting input pin **3** of **U5**, which is preferably a LM6361 type operational amplifier. The output pin **6** of **U5** is connected through a diode **D3** through a resistive network of a 150K resistor **R10**, a 51 ohm resistor **R11**, and a 10K resistor **R12**, connected to the non-inverting input pin **4** of **USA**. A 1.8 nF capacitor **C12** is connected between resistors **R11** and **R12**.

Positive feedback for **U8A** is provided by a 560K ohm resistor **R16**, while diode **D4** and a 470 ohm resistor **R15** are connected in the output pull-up path of **U8A**. A pair of inverters **U9D** and **U9E** formed from the hex inverter **U9** are connected in parallel to drive output DR from the TC output of **U7** at pin **14**. The output of **U8A** is connected to a digital logic inverter **U9F** to provide output signal DW. **U1** can accurately identify the start of a new field and has field index and back porch gate outputs. Signal DW is a bit stream of the clock run-in pulses **22** and the data bits in window **24**. Signal DR is active (high) only when line **21** in field **1** is being processed.

The operation of this portion of the circuit is as follows. Signal DR is normally low and goes high only when NTSC line **21** is present. Signal DW goes active only during NTSC line **21**. Line **21** is identified by **U1**, **U4** and **U7**. **U1** accepts the composite video signal as input on pin **2** and produces output signals at pins **7** and **5**. The FIELD signal at pin **7** of **U1** is high (+5 volts) when NTSC field **1** is being received and low (0 volts) when NTSC field **2** is being received. The BP signal from pin **5** of **U1** is a 4.8 usec pulse that occurs in the middle of the back porch **4S** following the horizontal sync pulse **38**. Counter **U7** is initialized by the FIELD signal at the beginning of field **1** and is counted down by the pulses from BP. When line **21** is reached, pin **14** on **U7** goes low for one scan line, thus creating the line **21**

gate signal DR. The next pulse on BP causes pin **14** on U7 to return to the high state which sets the flip flop U4 and terminates counting by U7 until the next frame. The signal pulse BP is also used to sample the video signal to create a black reference level. When BP is active, it turns on Q1, allowing the black level of the back porch **25** to be sampled and stored on capacitor C10. The peak value of the video of line **21** is stored on capacitor C12. The voltage difference between the voltages stored on C10 and C12 is divided by the resistors R13 and R12 to create a reference level that is about half way between the two levels. This reference level is applied to pin **4** of U8A and the composite video signal is applied to pin **5** of U8A. U8A is a high speed comparator which, as a result of comparing the composite video signal to the reference level will provide a digital logic signal at pin **12**. This signal is inverted by U9F to produce signal DW. Signal DW is normally clamped high, but during line **21** when DR goes high, signal DW is released and carries a digital logic waveform consisting of a digital representation of clock run in pulses **42** and data bits of window **44** in line **21**.

Referring now to FIG. 3*b*, signals DW and DR are processed to extract two characters for each occurrence of line **21**, field **31**, containing closed captioned characters. Signal DW is delivered to the B input of each of U10 and U17, which are preferably a one shot or monostable multivibrator circuit type HC123, available from Signetics. U10 has a 3K3 resistor R18, a 330 pF capacitor C15, a 3K3 resistor R17 and a 5K potentiometer R19 (used to set the width of the pulse on pin **13** of U10), in addition to a 0.1 uF capacitor C16. U17 has a 4K resistor R20 and a 1 nF capacitor C17. U11 and U18 are preferably formed of a 74HC74 D-type flip flop available from Signetics. Diode D7 is connected to the DW signal line through a 3K3 resistor R21. Diode D5 is connected between pin **1** of U10 and pin **8** of U18. Gate U12A is preferably formed of a 74HC86 type integrated circuit available from Signetics and couples the Q output at pin **13** of U10 through a 33 pF capacitor C19 to a 503.5 kilohertz resonator X1 which may be a model 503B as manufactured by Murata. Resonator X1 connects to a 0.1 uF capacitor C21 and a network formed of a 220 pF capacitor C20, a 100K resistor R23, a 1K resistor R27 and 10K resistors R25 and R26 to provide a cleaned-up clock signal from pin **13** of U10 to both inputs of U8B, which is preferably a type LM319 voltage comparator with a 100K positive feedback resistor R24.

The DR signal passes through a 1K resistor R29 and enables the output of U8B at pin **7** and fed to one input of U12B which is an inverter formed of a 74HC86 integrated circuit. U14 is preferably a type HC40103 integrated circuit counter available from Signetics, and connected to operate as a divide-by-16 counter. Counter U14 has a 0.1 uF capacitor C22. Diode D8 couples the TC output from U14 pin **14** to pin **10** of U12B. The output of U12B at pin **8** is connected to the CLK inputs of U16, which is preferably a type HC595N 8-bit shift register, available from Texas Instruments.

Signal DR is also coupled through a 330 pF capacitor C18, to diode D6 and into an input of U12C. The output of U12C at pin **3** is connected to the R input (the reset input) at pin **10** of U15 and U16 which are both a type HC595N 8-bit shift registers. Signal DR is provided to connector P2 through a 470 ohm resistor R30. The outputs of U15 and U16 are connected to connector P2. Output enable signal lines EN1 and EN2 are similarly connected to connector P2.

The function of the circuitry shown in FIG. 3*b* is to process the signals DW and DR to load the serial bits of the two characters into a register which can be accessed by a parallel read operation. Signal DW is active only during NTSC line **21**. When it is active it is a digital logic waveform consisting of the 7 cycles of the clock run-in followed by one start bit and two 8 bit data characters. The rising edges of the clock run-in pulses trigger two one shots U10 and U17. The function of the one shot circuit U10 is to derive a normalized clock signal. The normalized clock signal from pin **13** on U10 is used to energize the resonator X1 which is tuned to the clock run-in signal frequency of 503.5 KHz. The resonator X1 signal is squared up by the comparator U8B. Referring also to FIG. 2, the period of the clock run-in signal is 1.98 usec per cycle and the seven cycles are followed by 3.972 usec of low signal level. The one shot formed by U17 is retriggerable and times out after the end of the clock run-in pulses **42**, resulting in the setting of the flip flop U11. Setting U11 unclamps the clock input on U18. The next data rising edge will be the start bit which will then set flip flop U18. U18 then releases the counter U14 and the shift registers U15 and U16. The counter U14 is initialized with a value of **16** and is driven by the clock from the resonator X1. The **16** data bits are subsequently clocked into the shift registers. When the counter hits zero, the signal on pin **14** of U14 goes low which terminates the clock signal to the shift registers U15, U16. After NTSC line **21**, signal DR goes low. Signal DR and the contents of the shift registers U15 and U16 are available to the microprocessor **19**. A high-to-low transition of DR can be used an an indication that the data is available in the shift registers U15, U16.

The data can be read from the shift registers U15 and U16, one 8 bit character at a time by controlling the chip enable signal lines EN1 and EN2 connected respectively to pin **13** of U15 and U16 as shown in FIG. 3*b*. The falling edge of the signal DR can be used to generate an interrupt on each port of the interface board. On each occurrence of an interrupt, microprocessor **19** reads the characters from the shift registers U15, U16 associated with the interrupt-generating port and stores the characters as data in a buffer in memory. Further processing of the data is controlled by firmware in the PMU as shown in FIGS. **4** and **5**.

It is to be understood that the closed captioning information channel supports a caption mode and a text mode in both a primary and a secondary language. The caption mode text is recorded on a video tape along with the commercial and is automatically broadcast when the tape is played. When present, the text mode is generated and transmitted by the broadcaster when the channel is not being used to carry caption mode data. The caption and text modes in both languages are time multiplexed into the one serial character channel. Control code characters are used to switch the character stream between caption mode and text mode and between the two languages.

The microprocessor **19** must separate the caption mode characters from the remainder of the character stream. The characters in the closed captioning text are organized into phrases and sentences complete with punctuation and control codes. In caption mode, the control codes perform operations such as erasing the displayed captions, selecting the line on which the captions are to be displayed, setting colors for the charac-

ters, and controlling scrolling of the captions on the television set. For the purposes of this system, the caption text can be considered to be a series of paragraphs where a paragraph is the series of characters between two successive commands to clear the captions from the screen. The characters in a paragraph can be organized into phrases and sentences.

The command to erase displayed captions occurs relatively frequently; typically at any significant scene change. Every commercial begins and ends with a command to erase the displayed captions. Therefore, a commercial can include one or more paragraphs of caption text. Microprocessor **19** recognizes commercials by extracting the caption mode text from the continuing character stream, organizing this text into sensed paragraphs and then comparing each sensed paragraph to a library of stored paragraphs for the commercials that the system has been trained to recognize. Each stored paragraph in the library preferably has a corresponding commercial ID number.

In one embodiment, sensed paragraphs are compared directly to stored paragraphs. In an alternative embodiment, the caption mode paragraphs are compressed by a data compression algorithm. The data compression algorithm processes the variable length string of ASCII characters that comprise the paragraph and produces a shorter and preferably unique string or key of encoded bytes. A number of algorithms are known to those skilled in the art; a preferred data compression algorithm is Adaptive Lempel-Ziv Coding, which may be found in an article by Terry Welch entitled "A Technique For High Performance Data Compression," pp. 8–19 of Vol. 7, No. 6, of *IEEE Computer*, June 1984. One alternative algorithm or technique which may be used is Huffman Encoding, which may be found in an article by Jonathan Amsterdam entitled "Data Compression with Huffman Coding," pp. 99–108 of Vol. 11, No. 5 of BYTE Magazine, May, 1986. A still further alternative is to use hash coding to form a key for data "compression." While a hash code key is irreversible in the sense that the original data cannot be recovered from the key, reversibility is not necessary for the practice of this invention. It is theoretically most desirable to have a one-to-one and only one-to-one correspondence between the original data and the key resulting from operation of the data compression algorithm on the original data. In other words, it is preferable to have one and only one set of original data correspond to a given key. Nevertheless, it is to be understood to be within the spirit and scope of this invention to use an algorithm having a less than ideal data-key correspondence, which, for example, can provide savings in operating speed, storage requirements or other practical considerations that outweigh the risk of error in using such an "imperfect" data compression algorithm.

Returning to a preferred embodiment, both sensed and stored paragraphs are processed by a data compression using adaptive Lempel-Ziv Coding to produce a unique multi-byte key. These keys can be stored in the library instead of the complete paragraph itself. The library in this case would include the multi-byte keys, each with a corresponding commercial ID number. When the system is identifying commercials, the sensed paragraphs (derived from the broadcast sources) are each put through the same algorithm or transform to produce a key which is then compared to the keys in the library.

FIG. **4** is a flow chart for the operation that performs the task of reading the characters into the microprocessor **19** and then forming the characters into paragraphs of caption mode text. This module is started by a higher level task and once started will continue to operate as an independent, interrupt driven task until cancelled by the task that initiated it. When the task is started at entry step **101** it acquires a pool of empty data buffers which are used to assemble the paragraphs and to transfer the completed paragraphs to the higher level task. At step **102** the module **100** initializes itself, fetches an empty data buffer (the "active" buffer) from the pool, and defaults to a caption mode active condition. It then proceeds to step **103** where it enters a suspended condition, waiting for an interrupt. When an interrupt occurs, the task proceeds to step **104** and reads the two characters from the signal processing module **8**. At step **105**, a test is made to determine if the secondary language bit is set; and if it is the characters are ignored and control returns to step **103** to wait for the next pair of characters. If the characters are in the primary language, the process proceeds to step **106** where a test is made to determine if the caption mode is active. If it is not active then the characters are text mode data that can be ignored and control is returned to step **103** to wait for the next two characters. However, the return to step **103** is made via step **107** where a test is made to determine if the characters received are the control characters that switch the character stream into caption mode. If this is true, then at step **108** the caption mode is set active. If the caption mode is active at step **106**, step **109** then tests the received characters to determine if they are the control characters that switch the character stream into text mode, i.e., to set caption mode not active. If so, control again returns to step **103** after setting the caption mode not active at step **110**. Control will proceed to step **111** only when caption mode characters are being received. Step **111** tests to determine if the characters received include the control codes to clear memory. If not, then these characters form part of the current paragraph and are added to the active buffer. However, before adding the characters to the active buffer, step **112** tests to determine if these characters are the first characters in this paragraph; and, if they are, at step **113** the active buffer is initialized with the time of day at which the characters are received. At step **114**, the characters received are added to the active buffer and control then returns to step **103** to wait for the next two characters. If the test at step **111** indicates that the control code to clear memory has been received then the contents of the active buffer represent a complete sensed paragraph. Before transferring the contents of the active buffer, i.e., the sensed paragraph, to the higher level task, a test is made at step **115** to determine if the active buffer is empty, since it is possible that the character stream may contain sequential clear commands and it is preferable to avoid transfer of empty active buffers to the higher level task. If the active buffer is not empty, then at step **116** the active buffer containing the paragraph just received is transferred to the higher level task.

FIG. **5** is a flow chart for the algorithm or task **119** that is used to compare the sensed paragraphs to the library of stored paragraphs. Task **119** processes the data buffers that are filled by and transferred from the module or task **100**. Task **119** processes the data buffers and releases them faster than task **100** can fill and transfer buffers to avoid build-up of a long data buffer queue.

Task **119** starts at step **120**. At step **121**, the task initializes itself, creates and passes a pool of data buffers to task **100**, and then transfers control to task **100** at step **101**. At step **122** it monitors the pool of data buffers until one is transferred from task **100**. At step **123**, the task **119** fetches the oldest available buffer in the queue. At step **124**, the buffer is examined for communication errors (parity checks); and if errors have occurred, the buffer is returned to the pool at step **125** and control returns to step **122**. At step **126**, data compression transformation is performed on the paragraph in the buffer to create a corresponding key or compressed character string. At step **127**, the library is searched for a matching key and, if a match is found, the commercial ID number is returned from the matching key file in the library. If there is no match, control returns through step **125** to step **122**. If a match is found, one additional test must be made before making an entry in the data log. Each commercial may include more than one closed captioning paragraph but it is desirable that the system make only one entry in the data log for each play of the commercial. Therefore, at step **129** a test is made to determine if the match is for a commercial ID that is current. If the match is not on a current commercial, at step **130** an entry is made in the data log and the current ID is set for the commercial that was just identified. Then the buffer is released at step **125** and the task returns to step **122** where it waits for a buffer to be ready. The current ID is reset at step **130** after a new commercial has been identified and cleared at step **131** whenever a match is not made on a valid paragraph.

As stated previously, at step **130** after a match is found, data is entered into a data log. Preferably, the data that is collected includes an ID number for the commercial, and the time at which it was broadcast. It is to be understood that once started, module **119** runs continuously until cancelled. Module **119** will continually process active buffers filled in module **100** and release empty buffers to the pool (for use by module **100**). Although not shown, it is to be further understood that the data log created by module **119** is preferably periodically interrogated and cleared.

One of the functions that the central computer **15** performs is the creation and maintenance of the library Of stored paragraphs, or data compression keys and commercial ID numbers. In FIG. **1**, a VCR **46** is preferably located at or near central computer **15**. The purpose of the VCR **46** is to generate (from video tape) the caption mode paragraphs for the commercials that the PMUs **8** are to recognize. The composite output of the VCR is directed to a demodulator—decoder module **48**, the output of which is input to the computer **15**. An operator enters the caption mode text for a commercial into the library by playing a taped copy of the commercial on the VCR while running a special program on the computer **15**. This program is called the library input program.

The algorithm or task **139** for the library input program is shown in FIG. **6**. Task **139** starts at step **140**. At step **141** task **139** initializes itself and starts the low level task **100** which reads the characters and assembles the sensed paragraphs. This task must also maintain a pool of data buffers which are shared with the low level task **100**. At step **142**, the operator inputs (via a keyboard of central computer **15**) the commercial ID number that is to be assigned to this commercial as well as any other information relevant to that commercial such as product category, manufacturer, agency, etc. At step **143**, the operator starts VCR **46** to play the tape of a commercial to be "memorized" by computer **15**. In the loop formed by steps **144**, **145** and **146**, task **139** accepts buffers until the tape is stopped. When the tape is stopped, the task **139** is allowed to proceed to step **147** where the paragraphs in the buffers are checked for communication errors (parity checks). If errors are detected, the task terminates at step **150** rejecting any library entry that is not perfect, preferably with a suitable error message for the operator. If there are no errors, at step **151** the task **139** performs the character string compression on each of the paragraphs. At step **152**, an entry is made in the library for each of the compressed strings.

The library created at step **152** is preferably transmitted to Program Monitoring Unit **8** via telephone network **14** at an appropriate time when remote system **2** is in communication with central computer **15**.

The data defining the household purchase of goods and services may be collected using the technique of consumer questionnaires. The questionnaires can be of the well-known paper diary type or the electronic diary type in which the panelist interacts with and completes the questionnaire on the household TV set **10**. In such a case, the purchase data collected from each household may be transmitted via network **14** but in any event is entered into the database on the central site computer **15**. It is to be understood that other methods of collecting the purchase data are contemplated, such as in-store or in-home UPC symbol scanners.

To facilitate the generation of reports, the central site computer **15** contains several tables in which the collected data is stored. The information that is retrieved from the households is stored in a viewing table **200** that contains the household indentification number **202**, the panel identification number **204** (for the case where there are multiple panels such as a test and control panel) and the program identification code **206** along with the time **208** and the date **210** that the program was identified as having been viewed in the home.

A separate demographic table **212** contains the household identification number **202**, panel identification number **204** along with a set of demographic data **214** associated with the household.

A program table **216** contains the character strings **218** for various programs along with their program identification codes **206** and other information associated with the program.

A purchase table **220** contains the collected purchase data **222** of goods and services associated with each household, as well as the program identification code **206** associated with the various brand categories, brand items and services. In addition, other tables may be maintained in the central computer database to facilitate the generation of various reports as desired.

One standard report that can be generated by the software in the central computer **15** is a program viewing report **224**. This report specifies how many households in the panel had their television sets tuned to a predetermined program on a specific date and time or during a preselected time period. Only the data collected from the households is needed to automatically produce this report. It is not necessary to have centrally monitored all possible channels on which the program of interest could have been broadcast to be able to identify the programs viewed in the panelists house. To generate this report a computer operator merely enters the program identification code (PIC) and the desired time period into the report generating software. The

software then automatically retrieves all records from the viewing table that contain the selected PIC and meet the requirement of the specified time period. The output would be a tabulation of the households that viewed the program and the number of times it was viewed by each household during the selected time period.

By using the data in the viewing table and purchase table the software can also generate a household purchase report **226** that lists all the households that have viewed a television program and purchased an associated service or product. To generate this report the operator runs a program that combines the viewing table and the purchase table using the household identification number as a key. The program then retrieves all records from the combined table that contain both the PIC and product or service selected by the operator for the time period of interest. The program then processes this data to produce a table listing the number of viewings of the commercial by each household and the quantity of associated products or services that were purchased by the household. Each of the reports described above can be generated for each panel for the case where multiple panels are being monitored. These separate reports permit the researchers to closely monitor the resulting purchase behavior of panels exposed to different amounts or types of commercials. Further reports can also be generated incorporating the households' demographic characteristics by combining the demographic table with one or more of the other tables. The manner in which the data is stored and collected permits the rapid generation of both standard and non-standard reports by querying the database at the central site.

The invention is not to be taken as limited to all of the details thereof, as modifications and variations thereof may be made without departing from the spirit or scope of the invention; for example, a system which monitors only households that are equipped with a cable converter **6** and a cable television signal; however, it is to be understood to be within the scope of the present invention to determine the television programs being viewed on a television set equipped with an external tuner receiving a signal via a conventional antenna. As an alternative, the cable converter shown in FIG. **1** can be replaced with a VCR used to select channels from a cable television feed or a conventional antenna. As a further alternative, when the tuner in the television set is used to tune to a signal from a cable television feed or from a conventional antenna, the PMU **8** can be adapted to monitor the programming being viewed in the household. By inserting a signal tap in the television set to feed the output of the television tuner to the decoder **18** in the PMU **8**.

What is claimed is:

1. A program monitoring unit for monitoring the viewing of television programs by collecting data with respect to cooperating television viewers or panelists at a remote location for later transmission to a central computer for processing, the program monitoring unit comprising:

a) comparison table storing means for storing an updatable table of character strings;

b) signal acquisition means for acquiring a television signal being viewed by the cooperating television viewer;

c) decoding means for decoding character strings from the closed captioning signal that is embedded in the viewed television signal;

d) matching means for matching decoded character strings with character strings found in the table of character strings;

e) memory means for storing the decoded character strings that match character strings found in the table of character strings;

f) modem means for periodically establishing telephone communications between the program monitoring unit and the central computer via a public switched telephone network to i) transfer the matched character strings stored in the memory means to the central computer and ii) periodically update the table of character strings stored in the comparison table storing means.

2. A program monitoring unit in accordance with claim **1** wherein the character strings stored by the program monitoring unit are stored along with the date and time at which they were decoded.

3. A program monitoring unit in accordance with claim **2** wherein each character string and the date and time at which it was decoded is transferred to the central computer to allow the central computer to determine when the television program was viewed.

4. A program monitoring unit in accordance with claim **1** wherein the television programs identified are television commercials.

5. A system for collecting data with respect to cooperating television viewers or panelists comprising:

a) a remote unit connected to a television receiver such that the remote unit is able to monitor television programs being viewed by the cooperating television viewers, the remote unit having

i) first memory means for electronically storing an updatable table of character strings and respective associated program identification codes such that every character string has a corresponding program identification code in the table;

ii) decoding means for decoding a character string from the closed captioning signal that is embedded in a television program being viewed;

iii) comparing means for comparing each decoded character string to the strings stored in the table to determine when a match is found;

iv) second memory means for storing as a data event in an event data log the program identification codes corresponding to table character strings found to match the decoded character strings;

b) a central computer;

c) communication means for periodically establishing telephone communications between the remote unit and the central computer, transferring the data events stored in the second memory means to the central computer, and for receiving updates to the updatable table of character strings; and

d) associating means in the central computer for associating the data events transferred from the remote unit with the television programs viewed.

6. A system in accordance with claim **5** wherein the data events stored by the remote unit further comprise a date and time at which the comparing means matched the decoded character string with the table character string.

7. A system in accordance with claim **5** wherein the television programs identified are television commercials.

8. A method of collecting data on television viewing experience of a plurality of television viewing panelists at remote household locations comprising the steps of:

a) monitoring a television signal being viewed by the panelists for character strings found in the closed captioning signal embedded in the television signal;

b) matching the closed captioning character strings to character strings stored in an updatable table;

c) recording a program identification code corresponding to the signal being viewed whenever a match is made in step b);

d) repeating steps a), b) and c) over a predetermined time interval;

e) periodically reporting the program identification codes recorded in step to a central computer via a telephone network; and

f) periodically receiving updates to the character strings stored in the table from the central computer.

9. The method of claim **8** wherein the television signal being viewed comprises a television commercial.

10. The method of claim **8** wherein step c) further comprises recording a time at which the signal was viewed.

11. The method of claim **10** wherein step c) further comprises recording the date on which the signal was viewed.

12. The method of claim **11** wherein step e) further comprises reporting the time and date recorded in step c) to the central computer.

13. A system for collecting data on television viewing experience comprising:

a) a central computer; and

b) a plurality of remote household program monitoring units, each unit having:

i) decoding means for decoding a character string from the closed captioning signal that is embedded in a television program currently being displayed on a television set in the household,

ii) code storage means for storing program identification codes,

iii) means for associating the decoded character string with one of the program identification codes;

iv) data log means for electronically storing the program identification code that is associated with the decoded character string in step ii),

v) modem means for:

1) periodically establishing telephone communication between each remote program monitoring unit and the central computer and

2) transferring the contents of the data log means from each remote unit to the central computer, and

3) updating the program identification codes stored in the code storage means.

14. The system of claim **13** wherein each program monitoring unit further comprises a real-time clock means for identifying and recording in the data log the date and time at which a particular television program was displayed.

15. The system of claim **14** wherein the particular television program displayed comprises a television commercial.

16. The system of claim **13** wherein the central computer further comprises

i) viewing table which contains a household identification number, a time and a date corresponding to each program identification code transferred from the data log means to the central computer; and

ii) report generating means for generating a program viewing report of how many households had their television sets tuned to a predetermined program.

17. The system of claim **16** wherein the viewing table further comprises a panel identification number for identifying a panel to which each respective household belongs.

18. The system of claim **16** wherein the central computer further comprises

iii) a demographic table comprising a set of demographic data for each respective household, and further wherein the report generating means utilizes said demographic data in said program viewing report.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 5,374,951

DATED : December 20, 1994

INVENTOR(S) : Russell J. Welsh, Toronto, Canada

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby **corrected as shown below:**

In Col. 6, Line 49, the word "PUMs" should be --PMUs--.

In Col. 8, Line 39, the word "USA" should be --U8A--.

In Col. 8, Line 64, "4S" should be --45--.

In Col. 13, Line 45, the word "Of" should be --of--.

Signed and Sealed this

Twenty-seventh Day of June, 1995

Attest:

BRUCE LEHMAN

Attesting Officer

Commissioner of Patents and Trademarks

US006751221B1

(12) **United States Patent**
Saito et al.

(10) **Patent No.: US 6,751,221 B1**
(45) **Date of Patent: Jun. 15, 2004**

(54) **DATA TRANSMITTING NODE AND NETWORK INTER-CONNECTION NODE SUITABLE FOR HOME NETWORK ENVIRONMENT**

(75) Inventors: **Takeshi Saito**, Tokyo (JP); **Yoshiaki Takabatake**, Kanagawa (JP); **Mikio Hashimoto**, Chiba (JP); **Yukio Kamatani**, Kanagawa (JP)

(73) Assignee: **Kabushiki Kaisha Toshiba**, Kawasaki (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/036,197**

(22) Filed: **Mar. 6, 1998**

Related U.S. Application Data

(63) Continuation-in-part of application No. 08/943,927, filed on Oct. 3, 1997, now abandoned.

(30) **Foreign Application Priority Data**

Oct. 4, 1996 (JP) P08-264496
Mar. 6, 1997 (JP) P09-052125
Dec. 9, 1997 (JP) P09-338895

(51) **Int. Cl.**[7] **H04L 12/56**
(52) **U.S. Cl.** **370/392**; 370/395.52; 370/401; 370/466
(58) **Field of Search** 725/78, 82, 79, 725/80, 81, 83, 84, 85; 370/393, 395.3, 395.31, 395.52, 395.54, 395.64, 400, 401, 252, 255, 389, 392, 395.1, 395.6, 395.61, 395.62, 395.63, 395.65, 464, 465, 466, 467, 471

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Primary Examiner—Chau Nguyen
Assistant Examiner—Soon-Dong Hyun
(74) *Attorney, Agent, or Firm*—Oblon, Spivak, McClelland, Maier & Neustadt, P.C.

(57) **ABSTRACT**

A data transmitting node and a network inter-connection node suitable for use in the home network environment. In a case of transmitting information data from a data transmitting node connected with a physical network to a receiving node connected with the physical network or another physical network, a data transmitting node transmits the control message including an IP address information of a data transmission destination, a header/channel information dependent on the physical network, and an information indicating that the information data to be transmitted according to the header/channel information is data in an upper layer of an IP layer. The information data is then transmitted to the receiving node, where the information data contains the header/channel information and data of the upper layer without IP packet encapsulation. A network inter-connection node operates similarly.

24 Claims, 82 Drawing Sheets

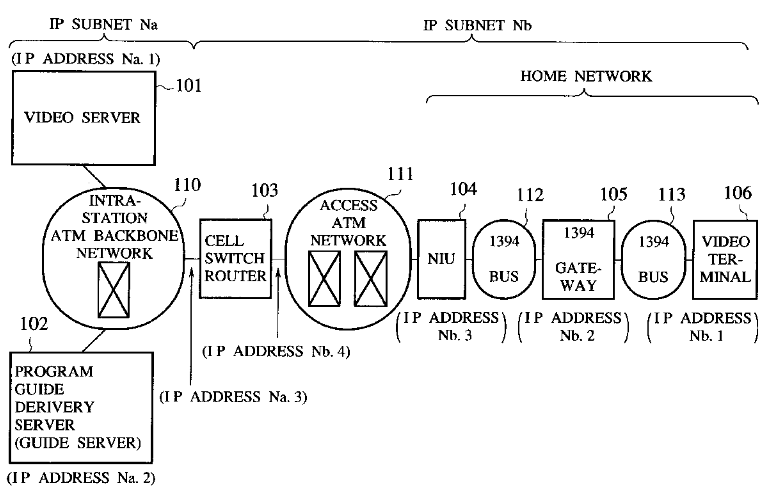


FIG.1

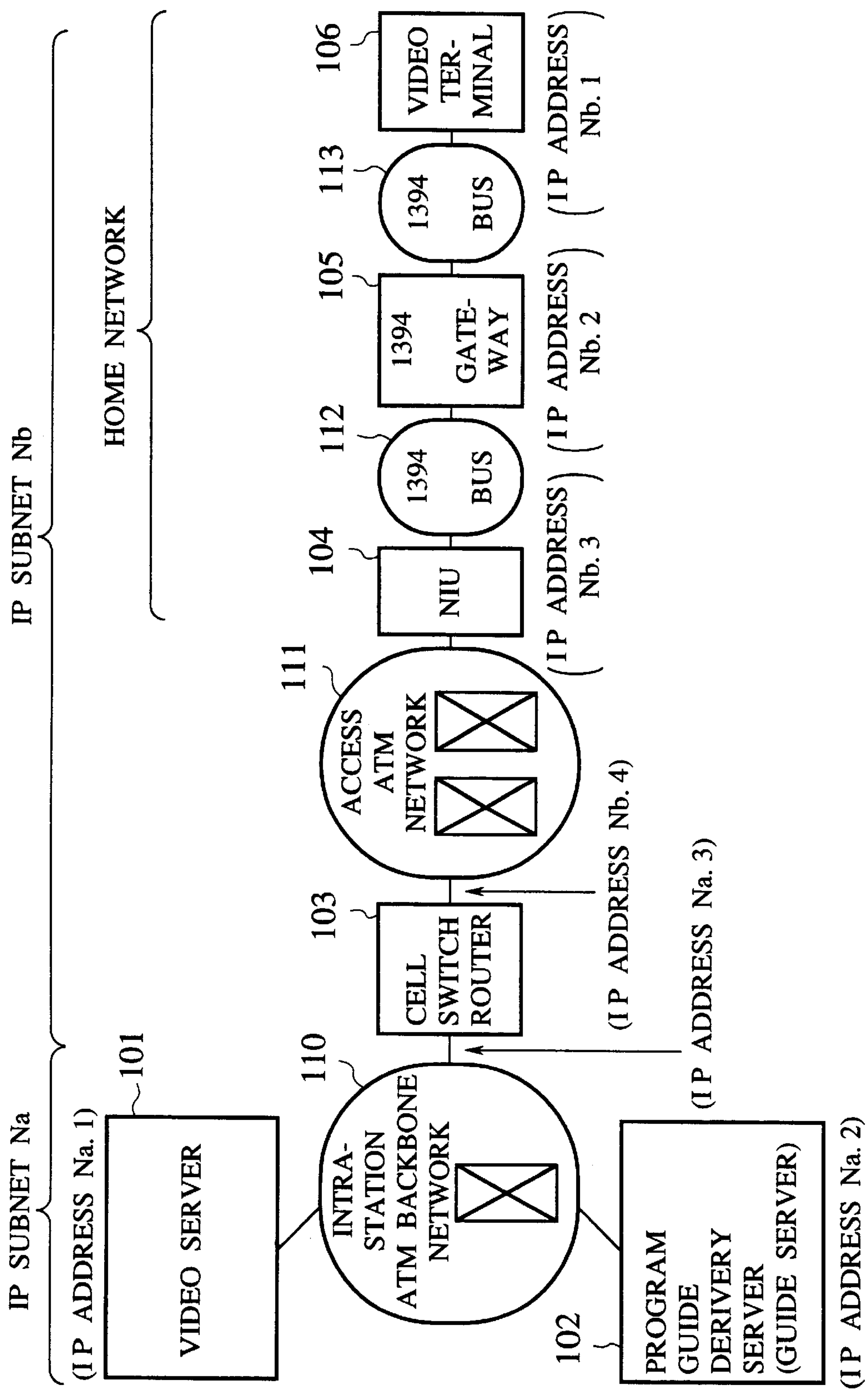

IP SUBNET Na
IP SUBNET Nb
HOME NETWORK
101
VIDEO SERVER
(I P ADDRESS Na. 1)
110
INTRA-STATION ATM BACKBONE NETWORK
102
PROGRAM GUIDE DERIVERY SERVER (GUIDE SERVER)
(I P ADDRESS Na. 2)
103
CELL SWITCH ROUTER
(I P ADDRESS Na. 3)
(I P ADDRESS Nb. 4)
111
ACCESS ATM NETWORK
104
NIU
(I P ADDRESS Nb. 3)
112
1394 BUS
105
1394 GATE-WAY
(I P ADDRESS Nb. 2)
113
1394 BUS
106
VIDEO TER-MINAL
(I P ADDRESS Nb. 1)

FIG.2

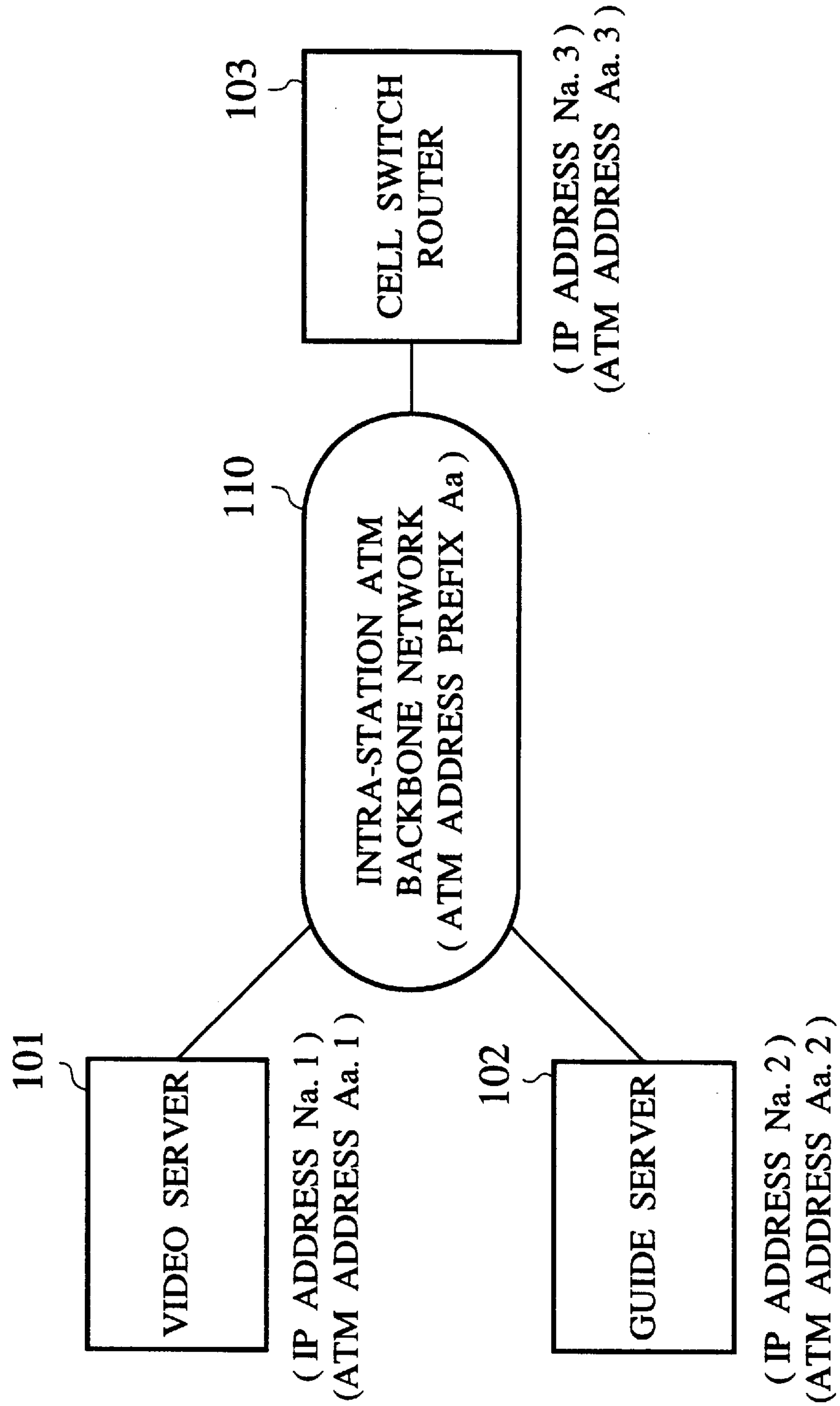

103
CELL SWITCH ROUTER
(IP ADDRESS Na. 3)
(ATM ADDRESS Aa. 3)
110
INTRA-STATION ATM BACKBONE NETWORK
(ATM ADDRESS PREFIX Aa)
101
VIDEO SERVER
(IP ADDRESS Na. 1)
(ATM ADDRESS Aa. 1)
102
GUIDE SERVER
(IP ADDRESS Na. 2)
(ATM ADDRESS Aa. 2)

FIG.3

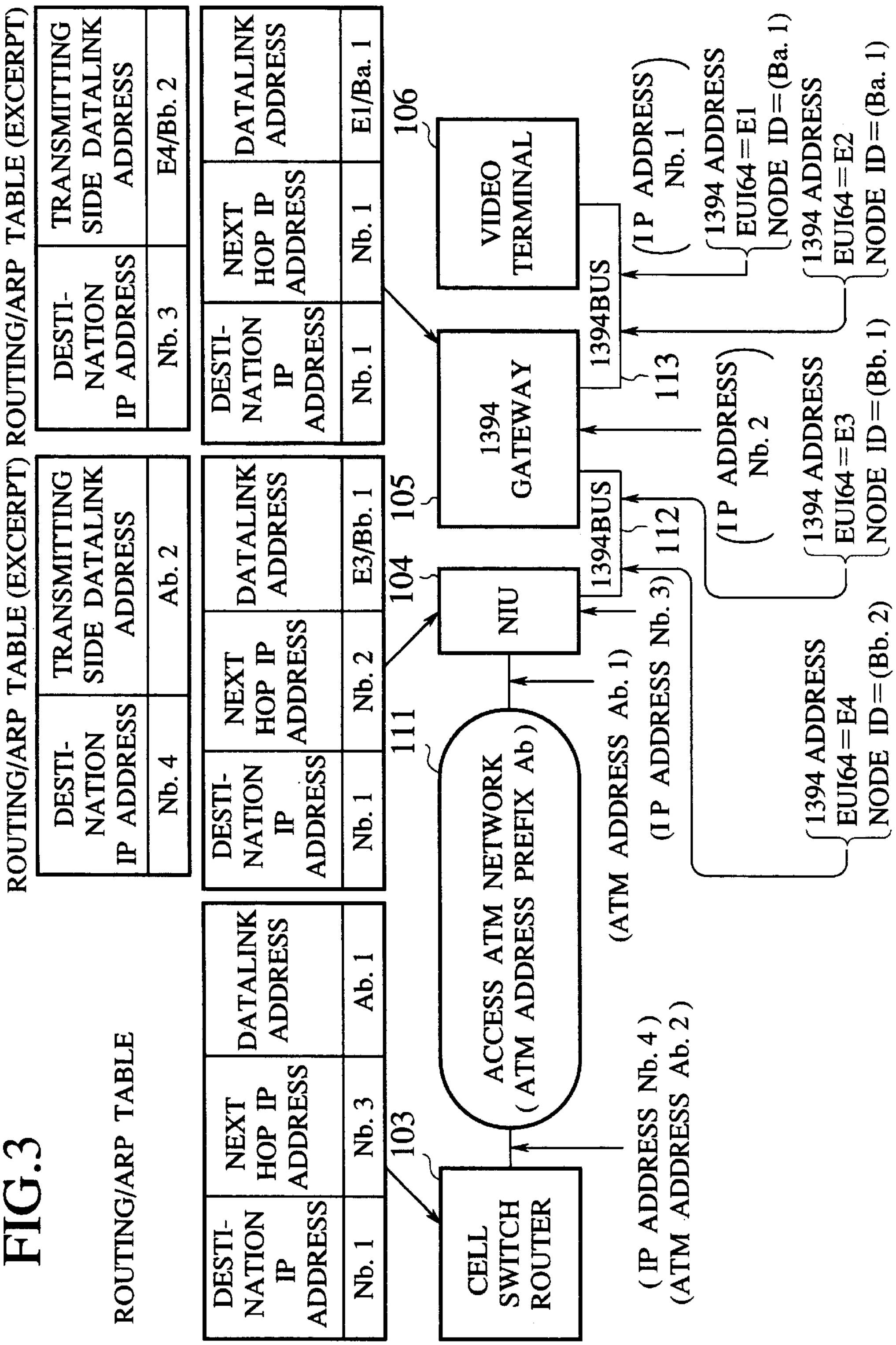

ROUTING/ARP TABLE
DESTINATION IP ADDRESS | NEXT HOP IP ADDRESS | DATALINK ADDRESS
Nb. 1 | Nb. 3 | Ab. 1
ROUTING/ARP TABLE (EXCERPT)
DESTINATION IP ADDRESS | TRANSMITTING SIDE DATALINK ADDRESS
Nb. 4 | Ab. 2
DESTINATION IP ADDRESS | NEXT HOP IP ADDRESS | DATALINK ADDRESS
Nb. 1 | Nb. 2 | E3/Bb. 1
ROUTING/ARP TABLE (EXCERPT)
DESTINATION IP ADDRESS | TRANSMITTING SIDE DATALINK ADDRESS
Nb. 3 | E4/Bb. 2
DESTINATION IP ADDRESS | NEXT HOP IP ADDRESS | DATALINK ADDRESS
Nb. 1 | Nb. 1 | E1/Ba. 1
103
CELL SWITCH ROUTER
111
ACCESS ATM NETWORK (ATM ADDRESS PREFIX Ab)
104
NIU
105
1394 GATEWAY
106
VIDEO TERMINAL
112
1394BUS
113
1394BUS
(IP ADDRESS Nb. 4)
(ATM ADDRESS Ab. 2)
(ATM ADDRESS Ab. 1)
(IP ADDRESS Nb. 3)
1394 ADDRESS EUI64=E4 NODE ID=(Bb. 2)
(IP ADDRESS Nb. 2)
1394 ADDRESS EUI64=E3 NODE ID=(Bb. 1)
(IP ADDRESS Nb. 1)
1394 ADDRESS EUI64=E1 NODE ID=(Ba. 1)
1394 ADDRESS EUI64=E2 NODE ID=(Ba. 1)

FIG.4

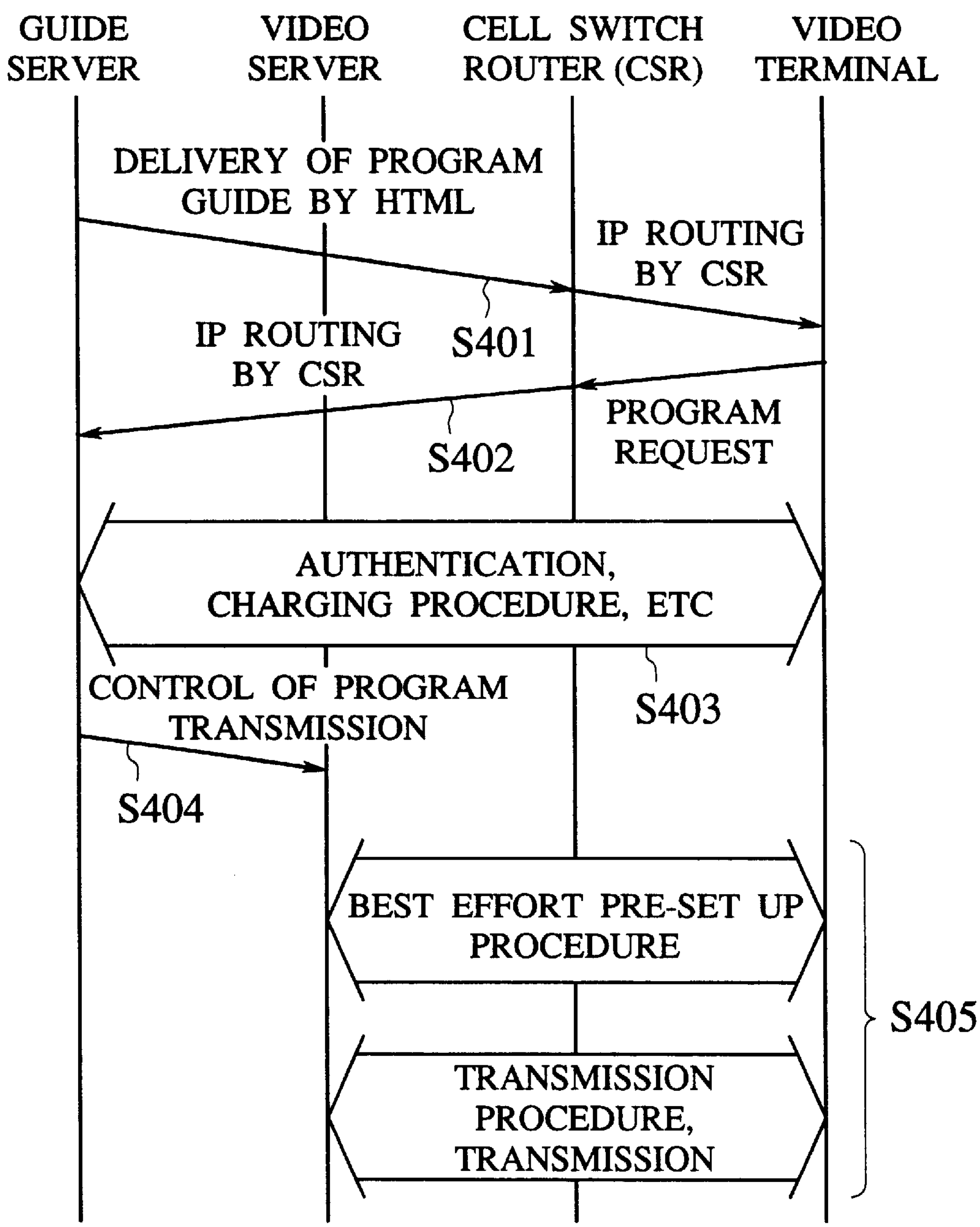

GUIDE SERVER
VIDEO SERVER
CELL SWITCH ROUTER (CSR)
VIDEO TERMINAL
DELIVERY OF PROGRAM GUIDE BY HTML
IP ROUTING BY CSR
S401
IP ROUTING BY CSR
PROGRAM REQUEST
S402
AUTHENTICATION, CHARGING PROCEDURE, ETC
S403
CONTROL OF PROGRAM TRANSMISSION
S404
BEST EFFORT PRE-SET UP PROCEDURE
TRANSMISSION PROCEDURE, TRANSMISSION
S405

FIG.5

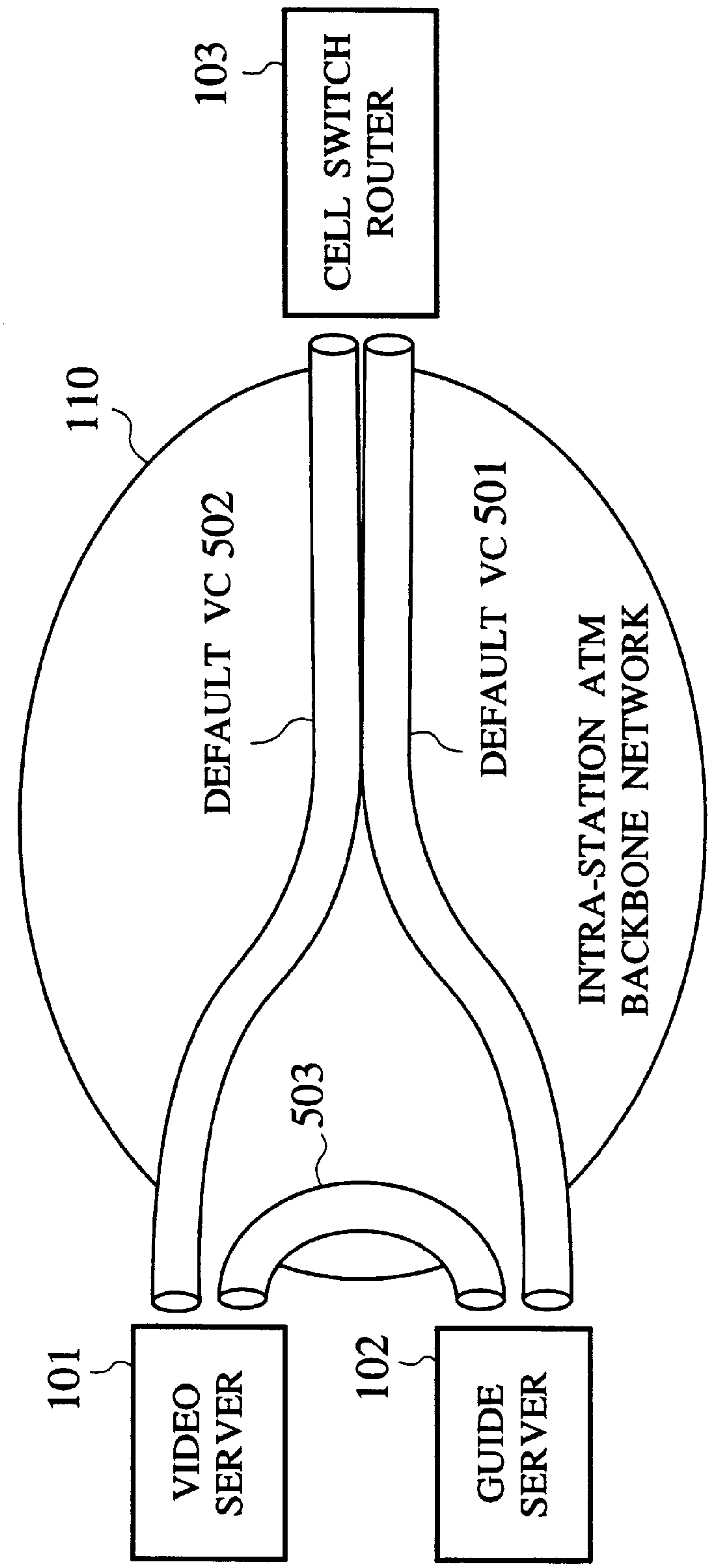

103
CELL SWITCH ROUTER
110
DEFAULT VC 502
DEFAULT VC 501
INTRA-STATION ATM BACKBONE NETWORK
503
101
VIDEO SERVER
102
GUIDE SERVER

FIG.6

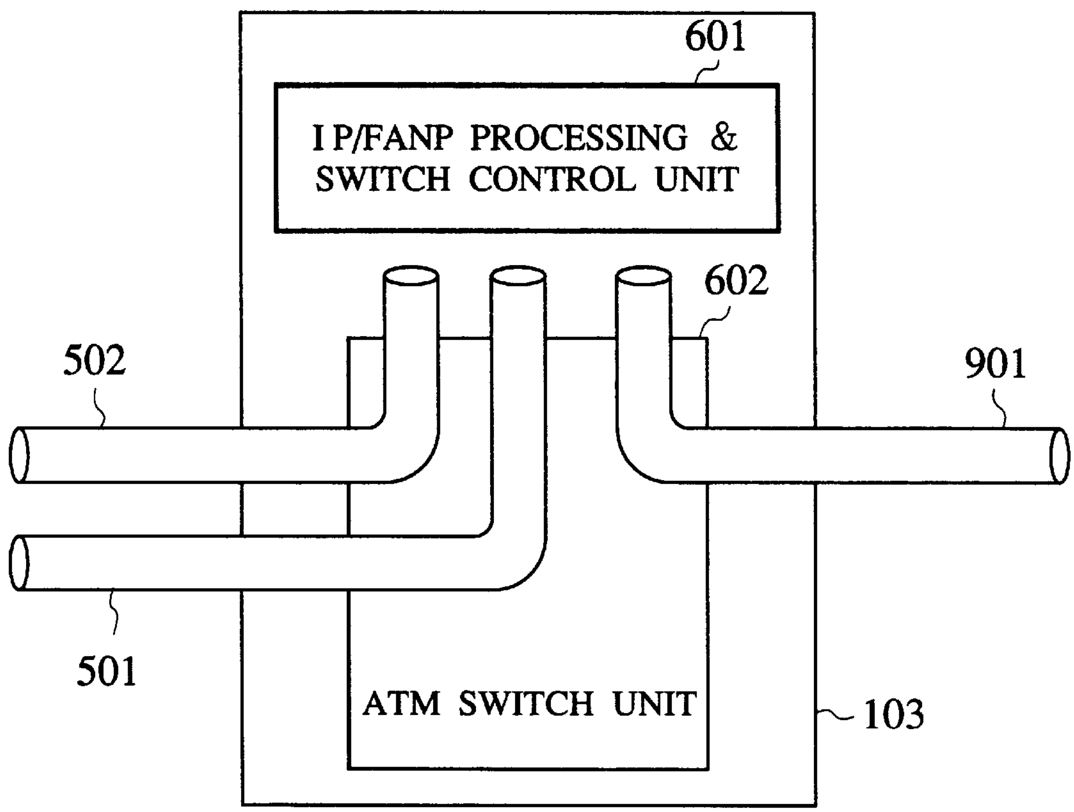

601
I P/FANP PROCESSING &
SWITCH CONTROL UNIT
602
502
901
501
ATM SWITCH UNIT
103

FIG.7

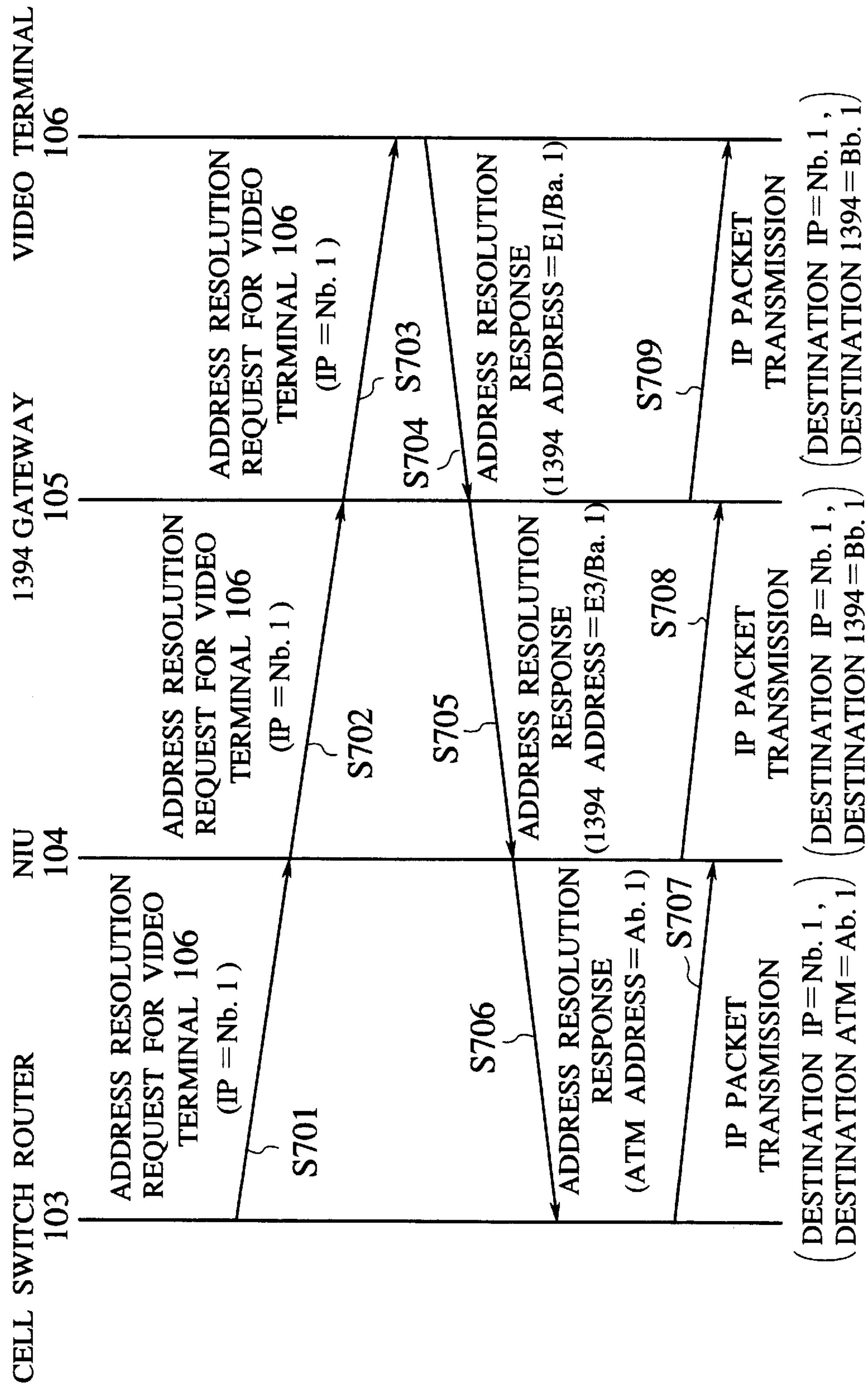

CELL SWITCH ROUTER 103
NIU 104
1394 GATEWAY 105
VIDEO TERMINAL 106
ADDRESS RESOLUTION REQUEST FOR VIDEO TERMINAL 106 (IP = Nb. 1)
S701
ADDRESS RESOLUTION REQUEST FOR VIDEO TERMINAL 106 (IP = Nb. 1)
S702
ADDRESS RESOLUTION REQUEST FOR VIDEO TERMINAL 106 (IP = Nb. 1)
S703
S704
ADDRESS RESOLUTION RESPONSE (1394 ADDRESS=E1/Ba. 1)
S705
ADDRESS RESOLUTION RESPONSE (1394 ADDRESS=E3/Ba. 1)
S706
ADDRESS RESOLUTION RESPONSE (ATM ADDRESS=Ab. 1)
S707
IP PACKET TRANSMISSION
(DESTINATION IP=Nb. 1, DESTINATION ATM=Ab. 1)
S708
IP PACKET TRANSMISSION
(DESTINATION IP=Nb. 1, DESTINATION 1394=Bb. 1)
S709
IP PACKET TRANSMISSION
(DESTINATION IP=Nb. 1, DESTINATION 1394=Bb. 1)

FIG.8

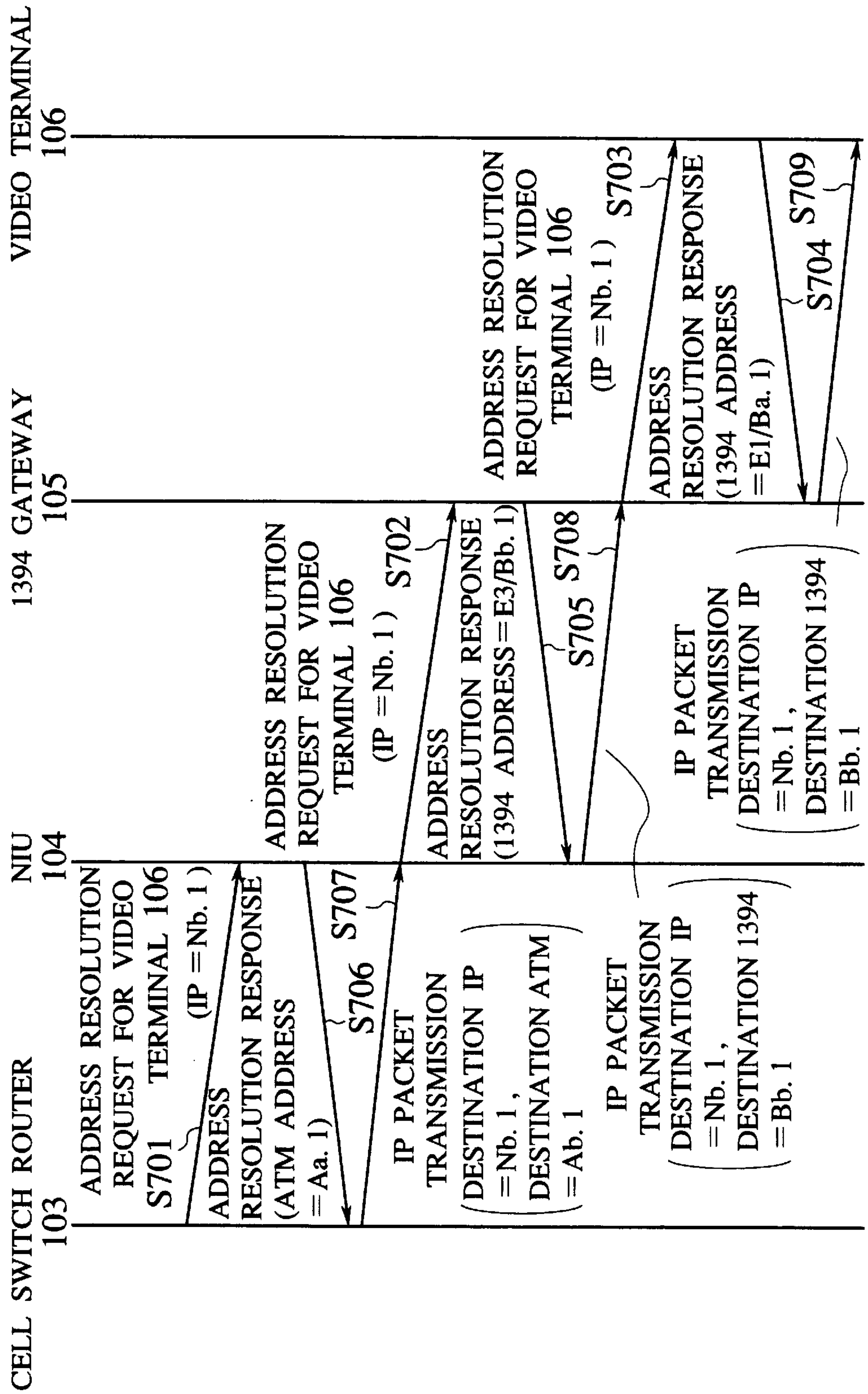
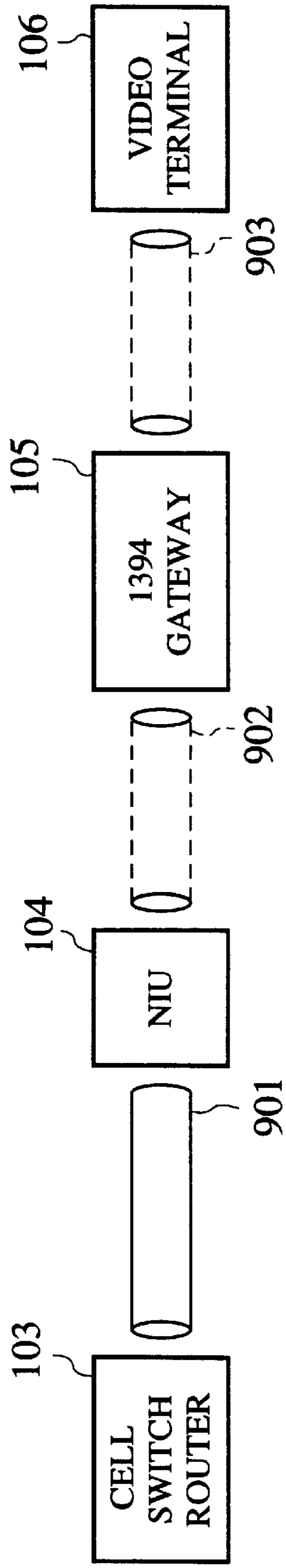
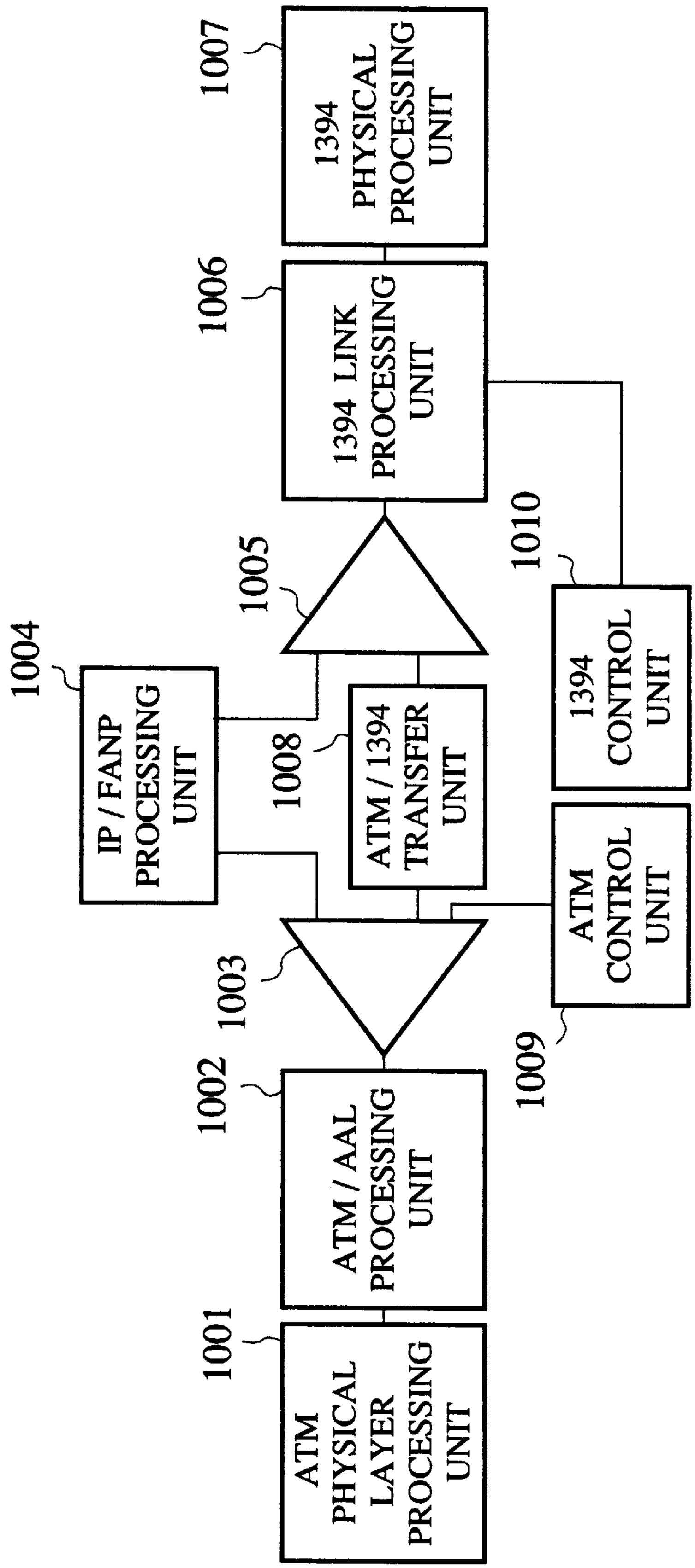

CELL SWITCH ROUTER 103
NIU 104
1394 GATEWAY 105
VIDEO TERMINAL 106
ADDRESS RESOLUTION REQUEST FOR VIDEO TERMINAL 106 (IP =Nb. 1)
S701
ADDRESS RESOLUTION RESPONSE (ATM ADDRESS =Aa. 1)
S706
S707
ADDRESS RESOLUTION REQUEST FOR VIDEO TERMINAL 106 (IP =Nb. 1)
S702
ADDRESS RESOLUTION RESPONSE (1394 ADDRESS=E3/Bb. 1)
S705
S708
ADDRESS RESOLUTION REQUEST FOR VIDEO TERMINAL 106 (IP =Nb. 1)
S703
ADDRESS RESOLUTION RESPONSE (1394 ADDRESS =E1/Ba. 1)
S704
S709
IP PACKET TRANSMISSION (DESTINATION IP =Nb. 1 , DESTINATION ATM =Ab. 1)
IP PACKET TRANSMISSION (DESTINATION IP =Nb. 1 , DESTINATION 1394 =Bb. 1)
IP PACKET TRANSMISSION (DESTINATION IP =Nb. 1 , DESTINATION 1394 =Bb. 1)

FIG.9



106
VIDEO TERMINAL
903
105
1394 GATEWAY
902
104
NIU
901
103
CELL SWITCH ROUTER

FIG.10



ATM PHYSICAL LAYER PROCESSING UNIT
1001
ATM / AAL PROCESSING UNIT
1002
1003
IP / FANP PROCESSING UNIT
1004
1005
1394 LINK PROCESSING UNIT
1006
1394 PHYSICAL PROCESSING UNIT
1007
ATM / 1394 TRANSFER UNIT
1008
ATM CONTROL UNIT
1009
1394 CONTROL UNIT
1010

FIG.11

DESTINATION IP ADDRESS	NEXT HOP IP ADDRESS	PHYSICAL PORT	DATALINK PHYSICAL ADDRESS
Nb. 1	Nb. 1	1394 SIDE	Bb. 1
Nb. 2	Nb. 2	1394 SIDE	Bb. 1
Nb. 4	Nb. 4	ATM SIDE	Ab. 2 (OR VCI)
Na	Nb. 4	ATM SIDE	Ab. 2 (OR VCI)
default	Nb. 4	ATM SIDE	Ab. 2 (OR VCI)
⋮	⋮	⋮	⋮

FIG.12

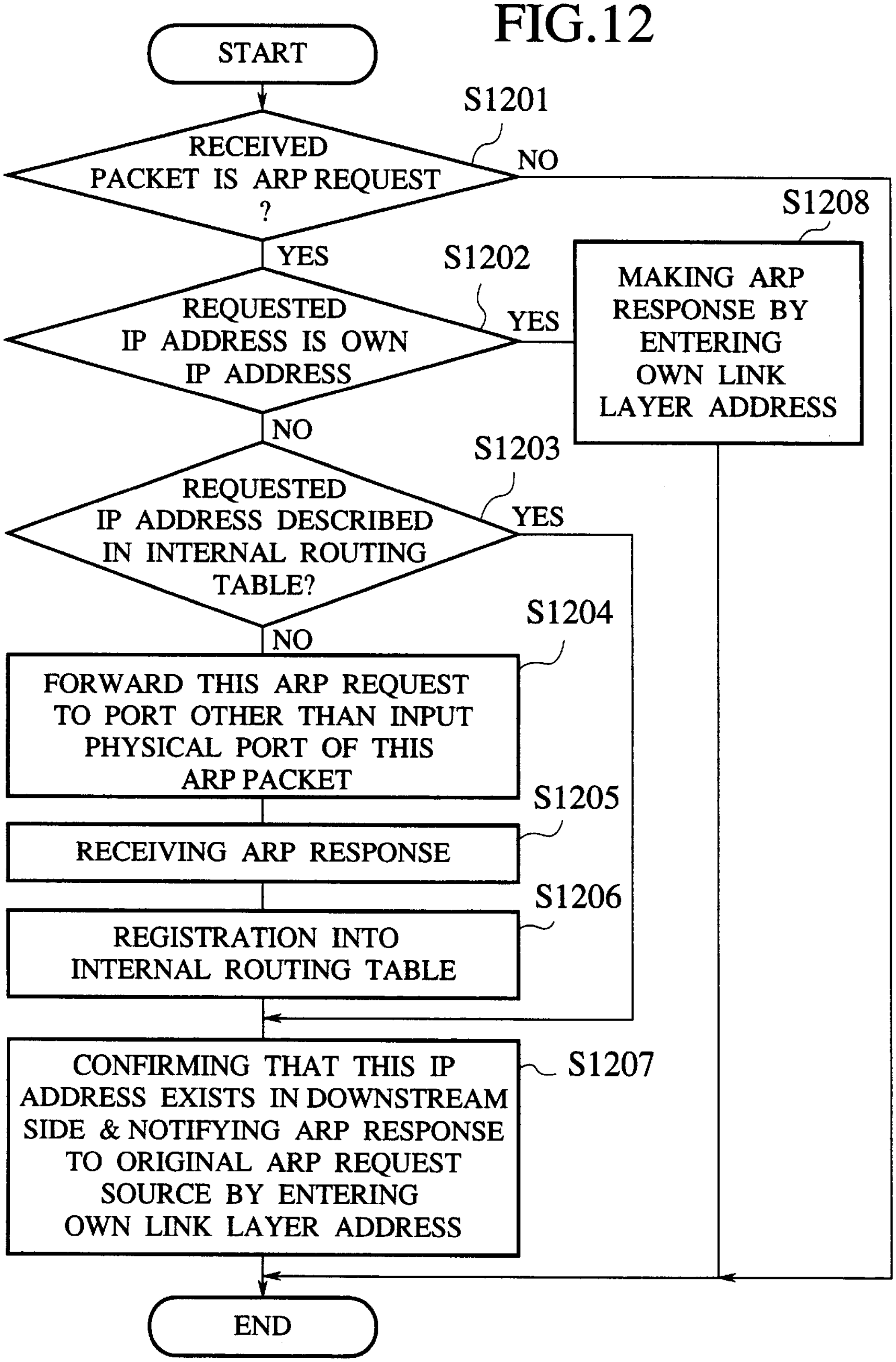

START
S1201
RECEIVED PACKET IS ARP REQUEST ?
NO
YES
S1208
MAKING ARP RESPONSE BY ENTERING OWN LINK LAYER ADDRESS
S1202
REQUESTED IP ADDRESS IS OWN IP ADDRESS
YES
NO
S1203
REQUESTED IP ADDRESS DESCRIBED IN INTERNAL ROUTING TABLE?
YES
NO
S1204
FORWARD THIS ARP REQUEST TO PORT OTHER THAN INPUT PHYSICAL PORT OF THIS ARP PACKET
S1205
RECEIVING ARP RESPONSE
S1206
REGISTRATION INTO INTERNAL ROUTING TABLE
S1207
CONFIRMING THAT THIS IP ADDRESS EXISTS IN DOWNSTREAM SIDE & NOTIFYING ARP RESPONSE TO ORIGINAL ARP REQUEST SOURCE BY ENTERING OWN LINK LAYER ADDRESS
END

FIG.13

1394 ASYNCHRONUOS PACKET HEADER		DESTINATION ID : BUS BROADCAST (ALL "1")
		SOURCE ID
		LENGTH FIELD, CRC, ETC.
STREAM TYPE		STREAM TYPE (LLC)
LLC / SNAP HEADER		LLC / SNAP HEADER (ETHERNET TYPE)
ARP PACKET	ARP HEADER	HARDWARE TYPE (1394)
		PROTOCOL TYPE (IP)
		OPERATION (ARP REQUEST)
		LENGTH, ETC.
	ARP DATA	TRANSMITTING SIDE 1394 ADDRESS (NODE ID)
		TRANSMITTING SIDE 1394 ADDRESS (EUI 64)
		TRANSMITTING SIDE IP ADDRESS
		RECEIVING SIDE 1394 ADDRESS (ALL "0" FOR UNKNOWN)
		RECEIVING SIDE IP ADDRESS
		CRC, ETC.

FIG.14

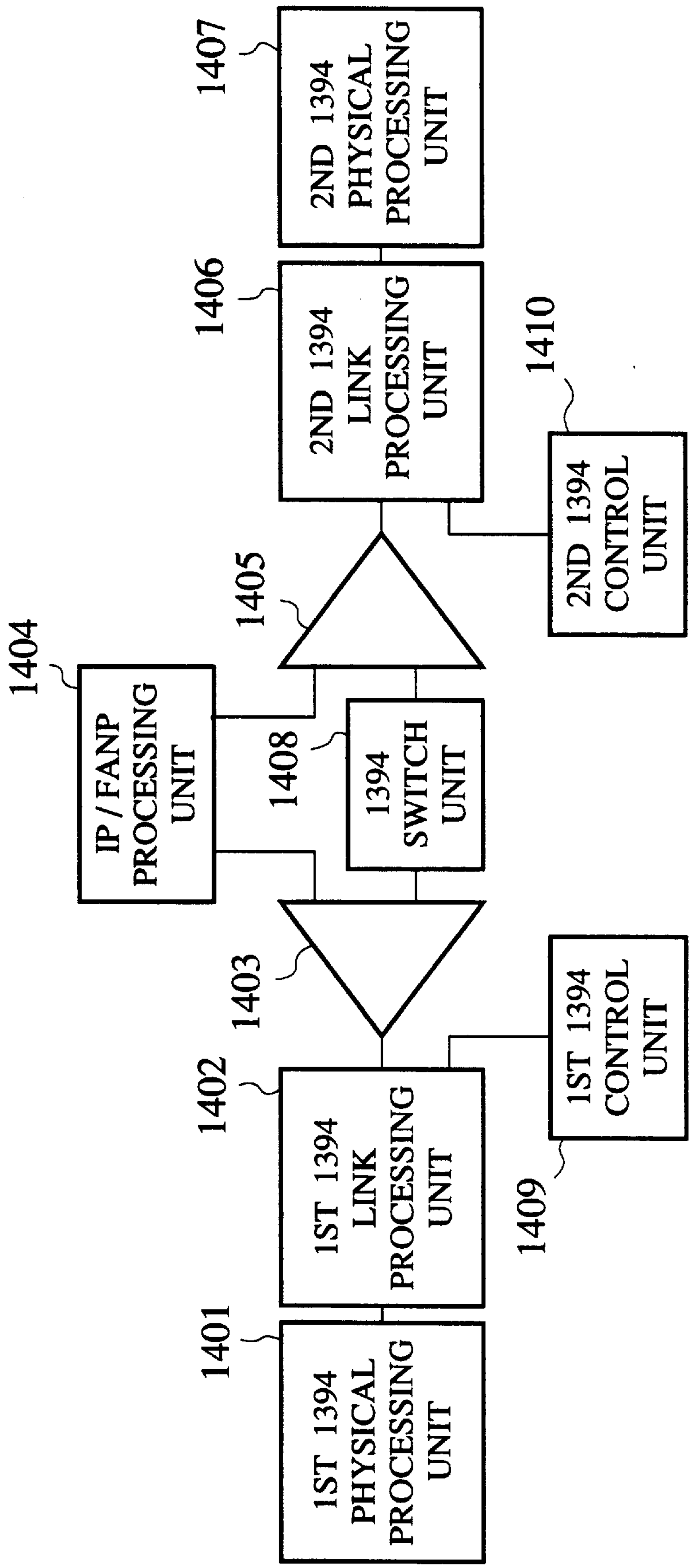

1401
1ST 1394 PHYSICAL PROCESSING UNIT
1402
1ST 1394 LINK PROCESSING UNIT
1403
1404
IP / FANP PROCESSING UNIT
1405
1406
2ND 1394 LINK PROCESSING UNIT
1407
2ND 1394 PHYSICAL PROCESSING UNIT
1408
1394 SWITCH UNIT
1409
1ST 1394 CONTROL UNIT
1410
2ND 1394 CONTROL UNIT

FIG.15

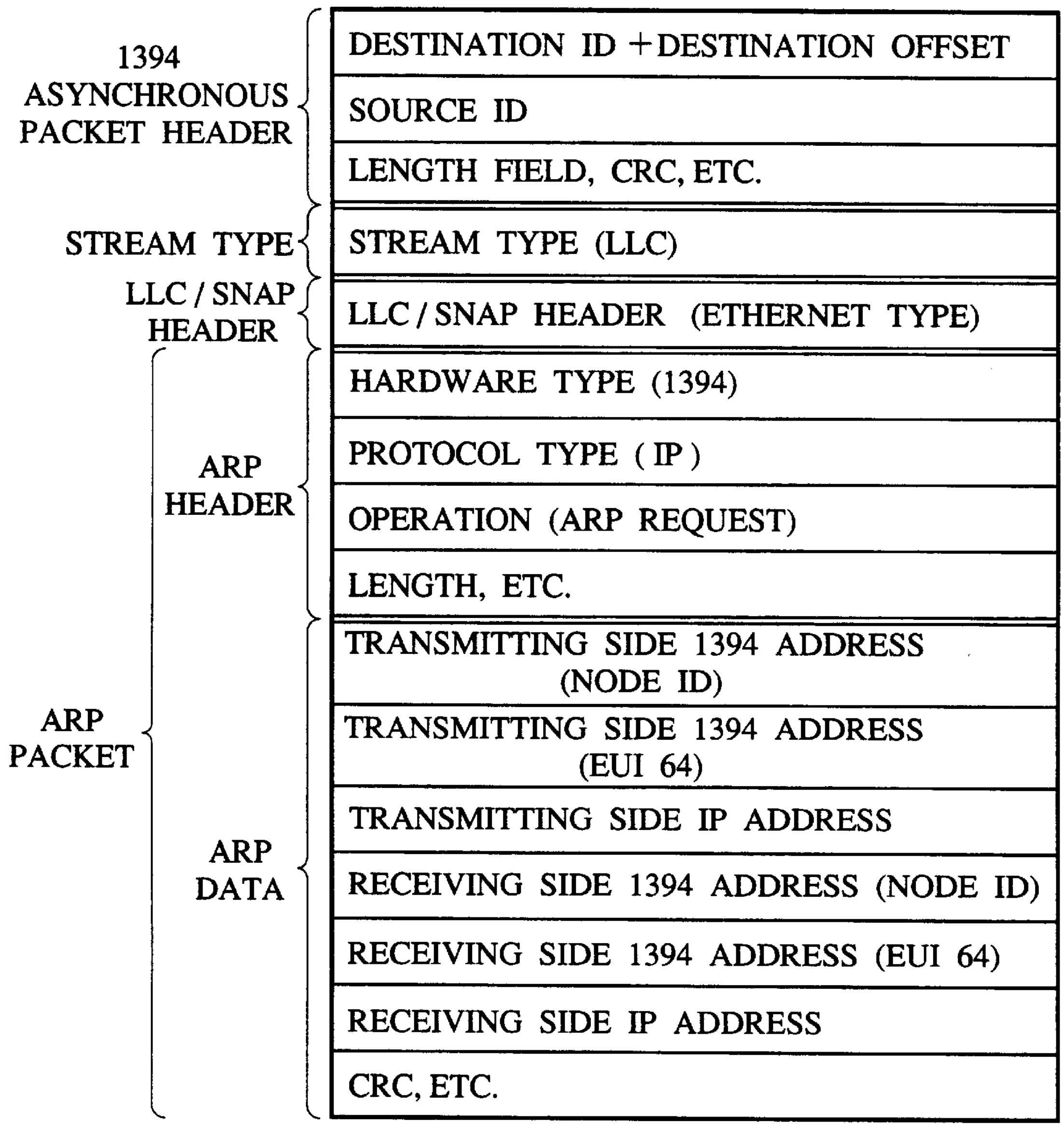

1394 ASYNCHRONOUS PACKET HEADER
DESTINATION ID +DESTINATION OFFSET
SOURCE ID
LENGTH FIELD, CRC, ETC.
STREAM TYPE
STREAM TYPE (LLC)
LLC / SNAP HEADER
LLC / SNAP HEADER (ETHERNET TYPE)
ARP HEADER
HARDWARE TYPE (1394)
PROTOCOL TYPE (IP)
OPERATION (ARP REQUEST)
LENGTH, ETC.
ARP PACKET
ARP DATA
TRANSMITTING SIDE 1394 ADDRESS (NODE ID)
TRANSMITTING SIDE 1394 ADDRESS (EUI 64)
TRANSMITTING SIDE IP ADDRESS
RECEIVING SIDE 1394 ADDRESS (NODE ID)
RECEIVING SIDE 1394 ADDRESS (EUI 64)
RECEIVING SIDE IP ADDRESS
CRC, ETC.

FIG.16

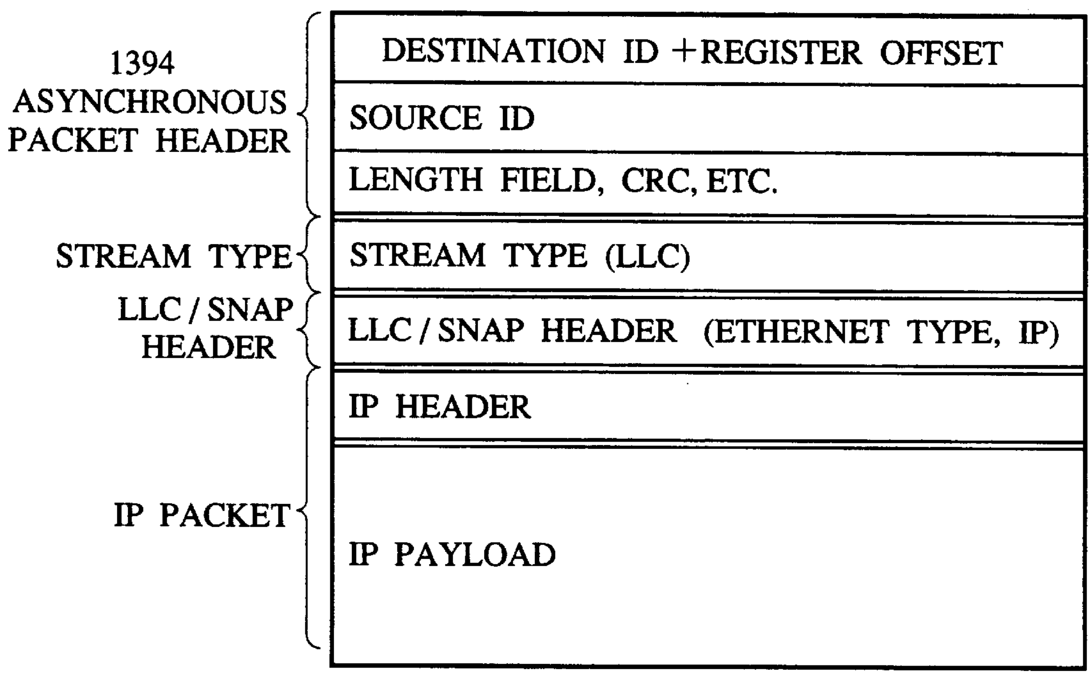

1394
ASYNCHRONOUS
PACKET HEADER
STREAM TYPE
LLC / SNAP
HEADER
IP PACKET
DESTINATION ID +REGISTER OFFSET
SOURCE ID
LENGTH FIELD, CRC, ETC.
STREAM TYPE (LLC)
LLC / SNAP HEADER (ETHERNET TYPE, IP)
IP HEADER
IP PAYLOAD

FIG.17

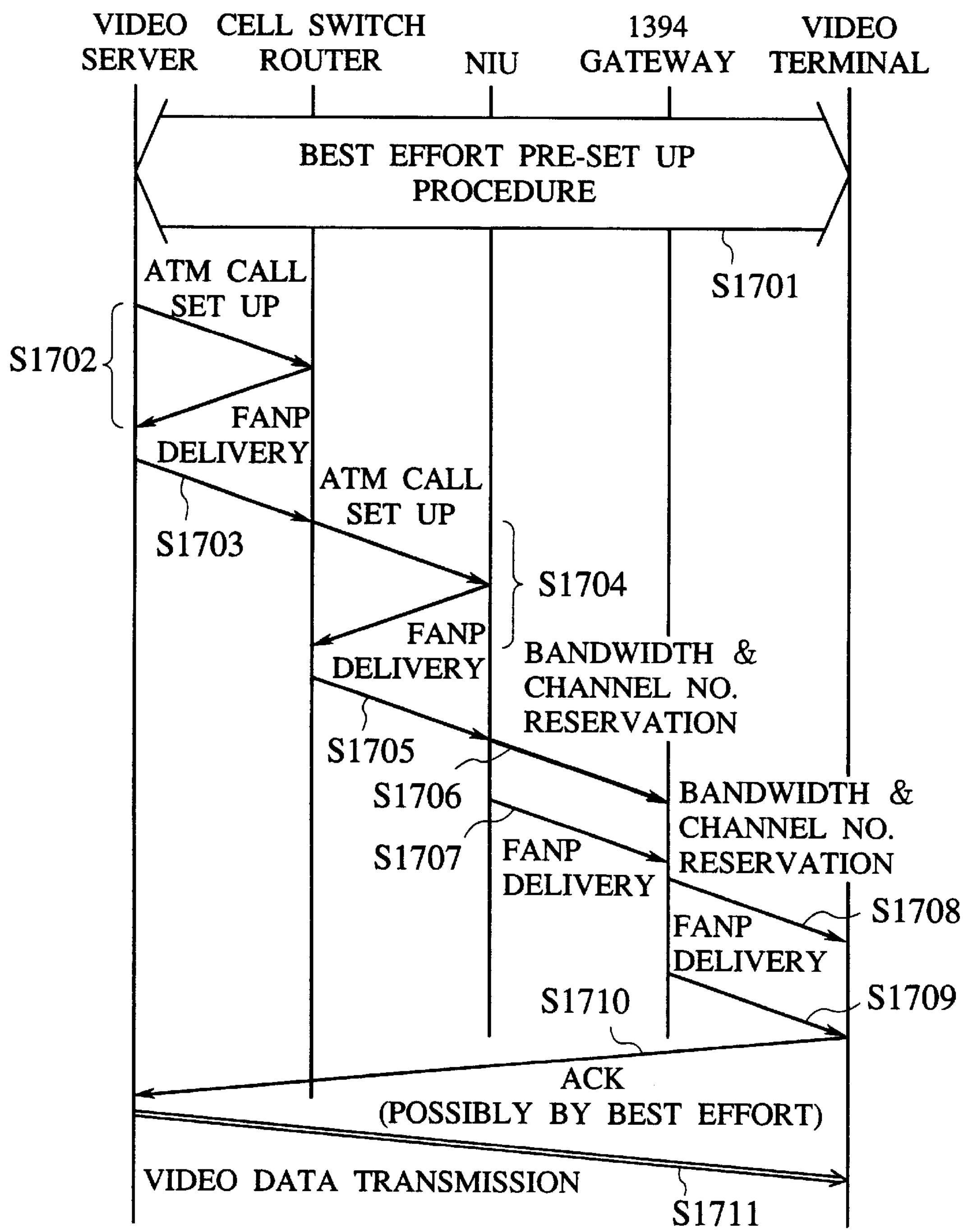

VIDEO SERVER
CELL SWITCH ROUTER
NIU
1394 GATEWAY
VIDEO TERMINAL
BEST EFFORT PRE-SET UP PROCEDURE
S1701
ATM CALL SET UP
S1702
FANP DELIVERY
S1703
ATM CALL SET UP
S1704
FANP DELIVERY
S1705
BANDWIDTH & CHANNEL NO. RESERVATION
S1706
S1707
FANP DELIVERY
BANDWIDTH & CHANNEL NO. RESERVATION
S1708
FANP DELIVERY
S1709
S1710
ACK (POSSIBLY BY BEST EFFORT)
VIDEO DATA TRANSMISSION
S1711

FIG.18

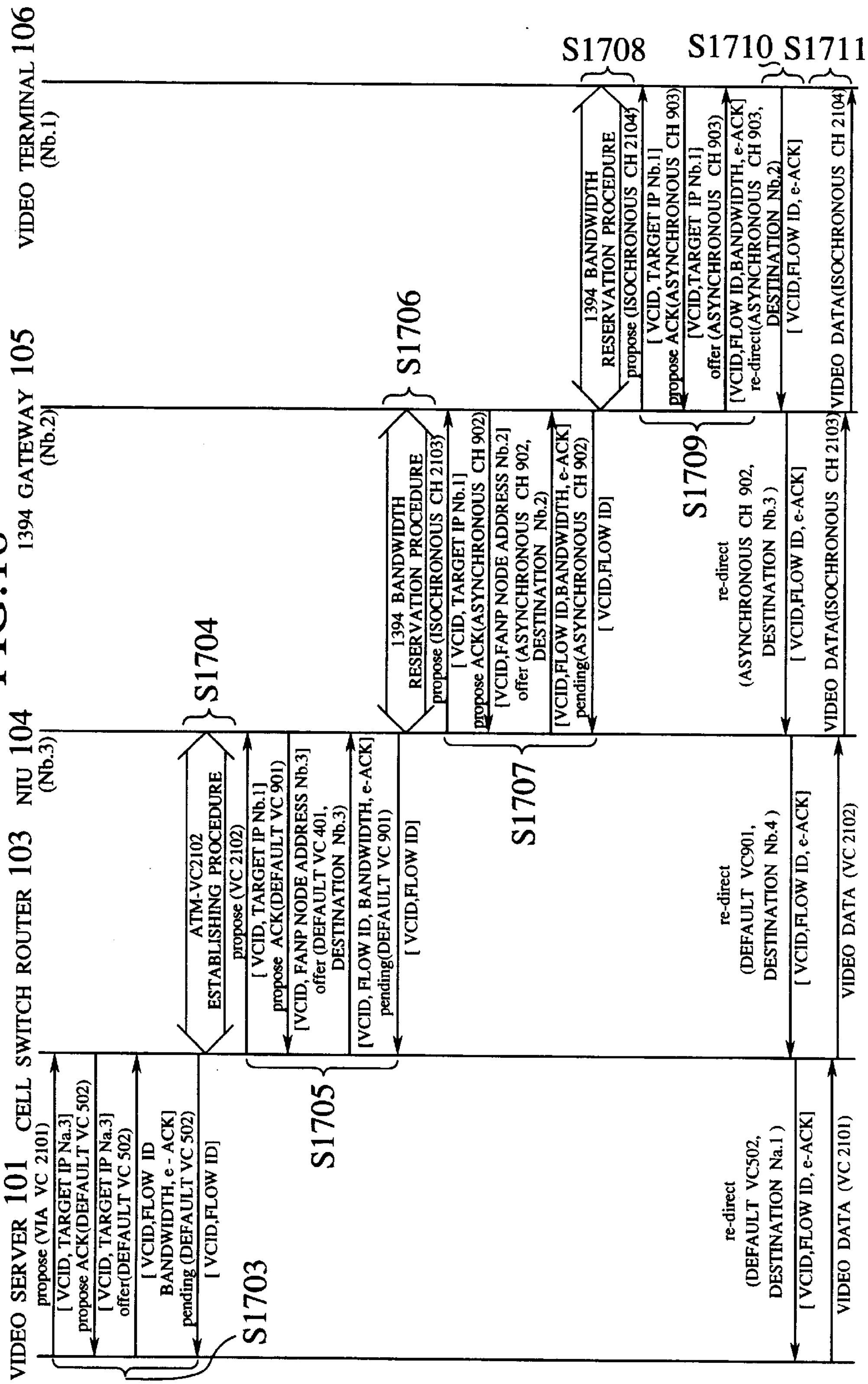

VIDEO SERVER 101
CELL SWITCH ROUTER 103
NIU 104 (Nb.3)
1394 GATEWAY 105 (Nb.2)
VIDEO TERMINAL 106 (Nb.1)
propose (VIA VC 2101)
[VCID, TARGET IP Na.3] propose ACK(DEFAULT VC 502)
[VCID, TARGET IP Na.3] offer(DEFAULT VC 502)
[VCID,FLOW ID BANDWIDTH, e - ACK] pending (DEFAULT VC 502)
[VCID,FLOW ID]
S1703
ATM-VC2102 ESTABLISHING PROCEDURE
propose (VC 2102)
[VCID, TARGET IP Nb.1] propose ACK(DEFAULT VC 901)
[VCID, FANP NODE ADDRESS Nb.3] offer (DEFAULT VC 401, DESTINATION Nb.3)
[VCID, FLOW ID, BANDWIDTH, e-ACK] pending(DEFAULT VC 901)
[VCID,FLOW ID]
S1704
S1705
1394 BANDWIDTH RESERVATION PROCEDURE
propose (ISOCHRONOUS CH 2103)
[VCID, TARGET IP Nb.1] propose ACK(ASYNCHRONOUS CH 902)
[VCID,FANP NODE ADDRESS Nb.2] offer (ASYNCHRONOUS CH 902, DESTINATION Nb.2)
[VCID,FLOW ID,BANDWIDTH, e-ACK] pending(ASYNCHRONOUS CH 902)
[VCID,FLOW ID]
S1706
S1707
1394 BANDWIDTH RESERVATION PROCEDURE
propose (ISOCHRONOUS CH 2104)
[VCID, TARGET IP Nb.1] propose ACK(ASYNCHRONOUS CH 903)
[VCID,TARGET IP Nb.1] offer (ASYNCHRONOUS CH 903)
[VCID,FLOW ID,BANDWIDTH, e-ACK] re-direct(ASYNCHRONOUS CH 903, DESTINATION Nb.2)
[VCID,FLOW ID, e-ACK]
VIDEO DATA(ISOCHRONOUS CH 2104)
S1708
S1709
S1710
S1711
re-direct (ASYNCHRONOUS CH 902, DESTINATION Nb.3)
[VCID,FLOW ID, e-ACK]
VIDEO DATA(ISOCHRONOUS CH 2103)
re-direct (DEFAULT VC901, DESTINATION Nb.4)
[VCID,FLOW ID, e-ACK]
VIDEO DATA (VC 2102)
re-direct (DEFAULT VC502, DESTINATION Na.1)
[VCID,FLOW ID, e-ACK]
VIDEO DATA (VC 2101)

FIG.19

INPUT CHANNEL NO. OR REGISTER OFFSET	ATTRIBUTE	OUTPUT PORT	OUTPUT CHANNEL NO. OR DESTINATION ADDRESS WITH REGISTER OFFSET
#1	MPEG, 4M	B	#5
#3	MPEG, 4M	B	#7
#5	AUDIO, 1M	B	#2
⋮	⋮	⋮	⋮

FIG.20

HAEDWARE TYPE (ATM)
PROTOCOL TYPE (IP)
OPERATION CODE (propose / propose ACK / NACK)
SENDER IP ADDRESS
TARGET IP ADDRESS OR FANP TERMINATING NODE IP ADDRESS
VCID

FIG.21

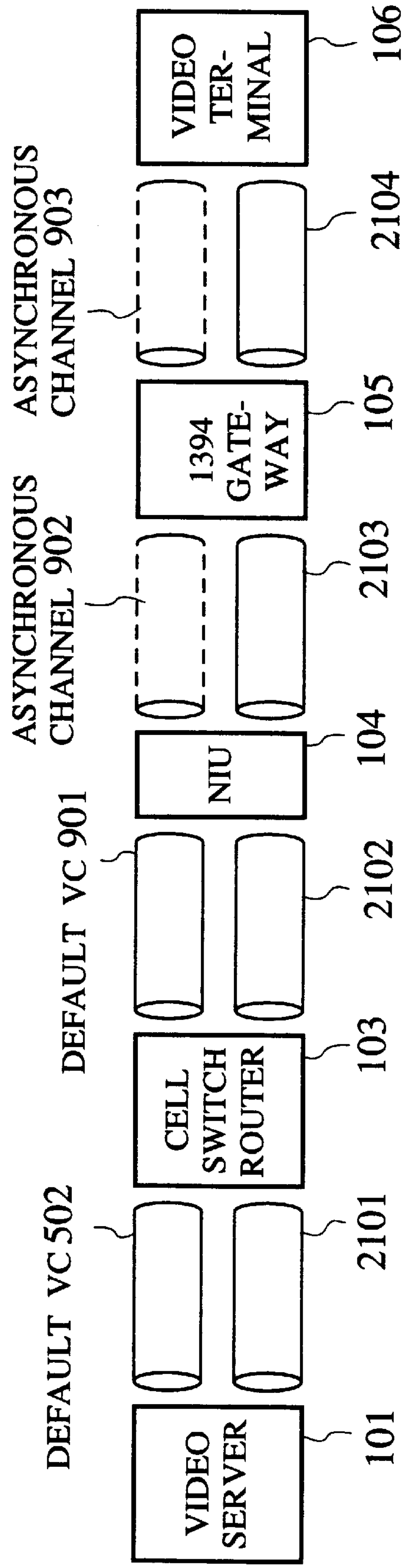
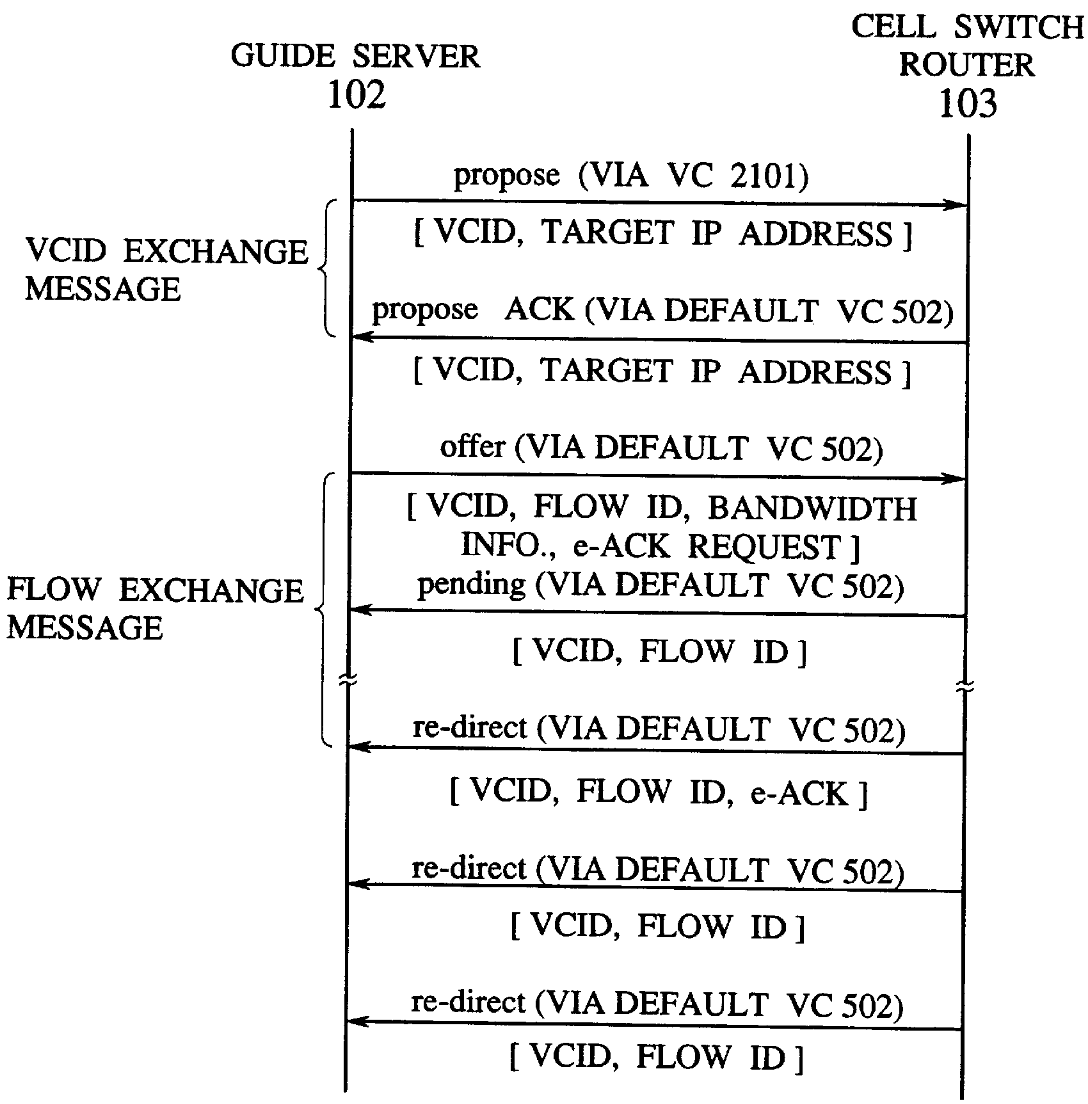

VIDEO SERVER
101
DEFAULT VC 502
2101
CELL SWITCH ROUTER
103
DEFAULT VC 901
2102
NIU
104
ASYNCHRONOUS CHANNEL 902
2103
1394 GATE-WAY
105
ASYNCHRONOUS CHANNEL 903
2104
VIDEO TER-MINAL
106

FIG.22



GUIDE SERVER
102
CELL SWITCH ROUTER
103
propose (VIA VC 2101)
[VCID, TARGET IP ADDRESS]
VCID EXCHANGE MESSAGE
propose ACK (VIA DEFAULT VC 502)
[VCID, TARGET IP ADDRESS]
offer (VIA DEFAULT VC 502)
[VCID, FLOW ID, BANDWIDTH INFO., e-ACK REQUEST]
pending (VIA DEFAULT VC 502)
FLOW EXCHANGE MESSAGE
[VCID, FLOW ID]
re-direct (VIA DEFAULT VC 502)
[VCID, FLOW ID, e-ACK]
re-direct (VIA DEFAULT VC 502)
[VCID, FLOW ID]
re-direct (VIA DEFAULT VC 502)
[VCID, FLOW ID]

FIG.23

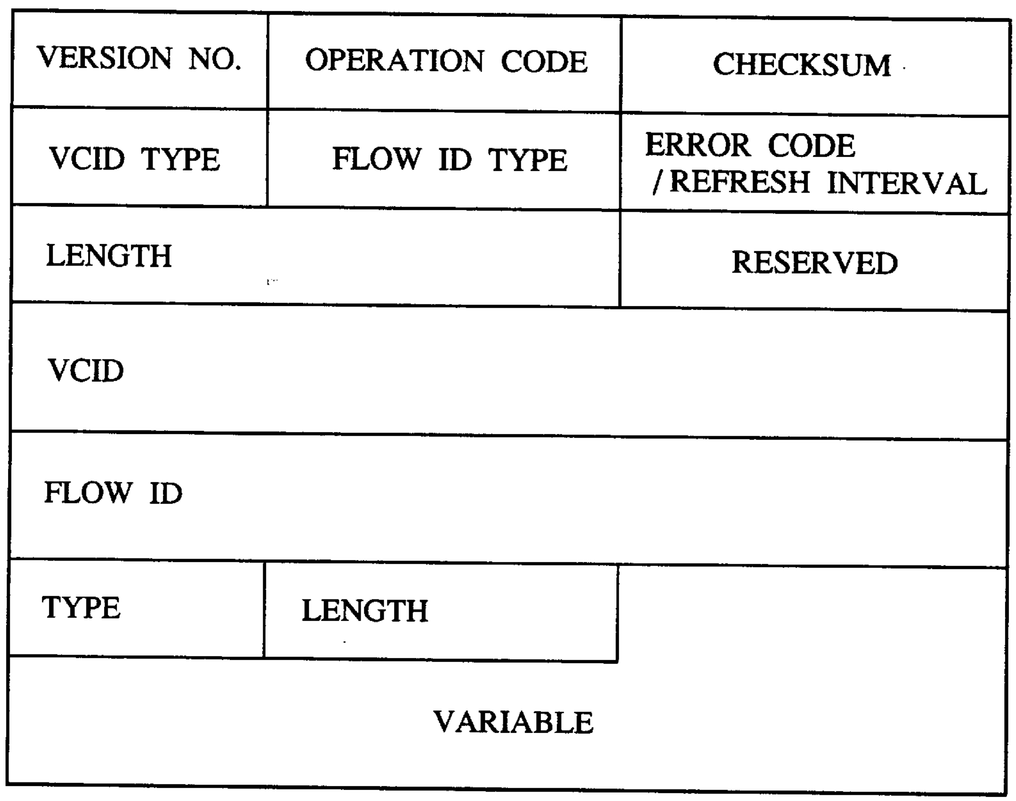

VERSION NO.
OPERATION CODE
CHECKSUM
VCID TYPE
FLOW ID TYPE
ERROR CODE /REFRESH INTERVAL
LENGTH
RESERVED
VCID
FLOW ID
TYPE
LENGTH
VARIABLE

FIG.24

VERSION=2	OPERATION CODE=1	RESERVED
VCID TYPE	FLOW ID TYPE	RERESH INTERVAL
LENGTH		RESERVED
VCID		
FLOW ID		
TYPE	LENGTH	COMMUNICATION ATTRIBUTE (MPEG)
TYPE	LENGTH	BANDWIDTH (COM-MUNICATION QUALITY)
TYPE	LENGTH	e-ACK REQUEST

FIG.25

VERSION=2	OPERATION CODE=6	RESERVED
VCID TYPE	FLOW ID TYPE	RESERVED
LENGTH		RESERVED
VCID		
FLOW ID		

FIG.26

1394 ASYNCHRONOUS PACKET HEADER

STREAM TYPE

LLC / SNAP HEADER

HARDWARE TYPE		PROTOCOL TYPE=0×800	
SHLen=0	SNUILen=0	OPERATION CODE	
SPLen	THLen=0	TNUILen=0	TPLen
SENDER IP ADDRESS			
TARGET IP ADDRESS OR FANP TERMINATING NODE IP ADDRESS			
VCID			

FIG.27

	VERSION=2	OPERATION CODE=1	RESERVED
	VCID TYPE	FLOW ID TYPE	RESERVED
	LENGTH		RESERVED
	VCID		
	FLOW ID		
OPTION	TYPE	LENGTH	e - ACK RESPONSE

FIG.28

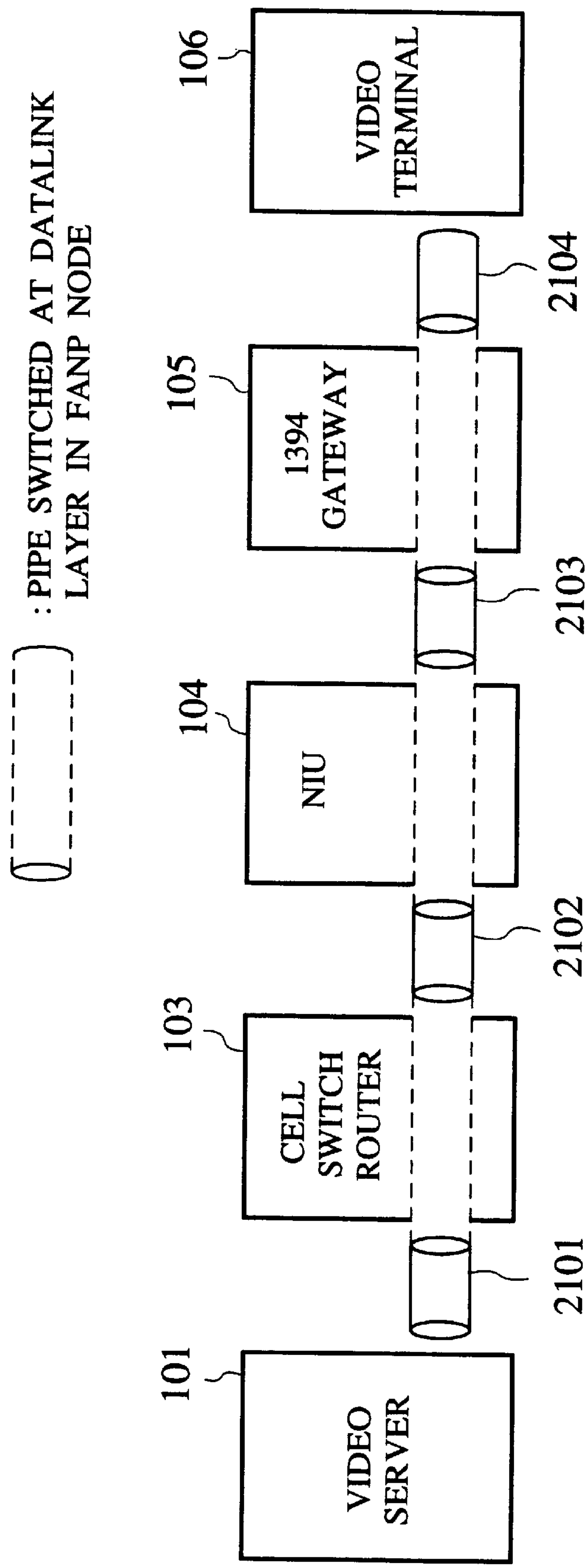

: PIPE SWITCHED AT DATALINK LAYER IN FANP NODE
101
VIDEO SERVER
2101
103
CELL SWITCH ROUTER
2102
104
NIU
2103
105
1394 GATEWAY
2104
106
VIDEO TERMINAL

FIG.29

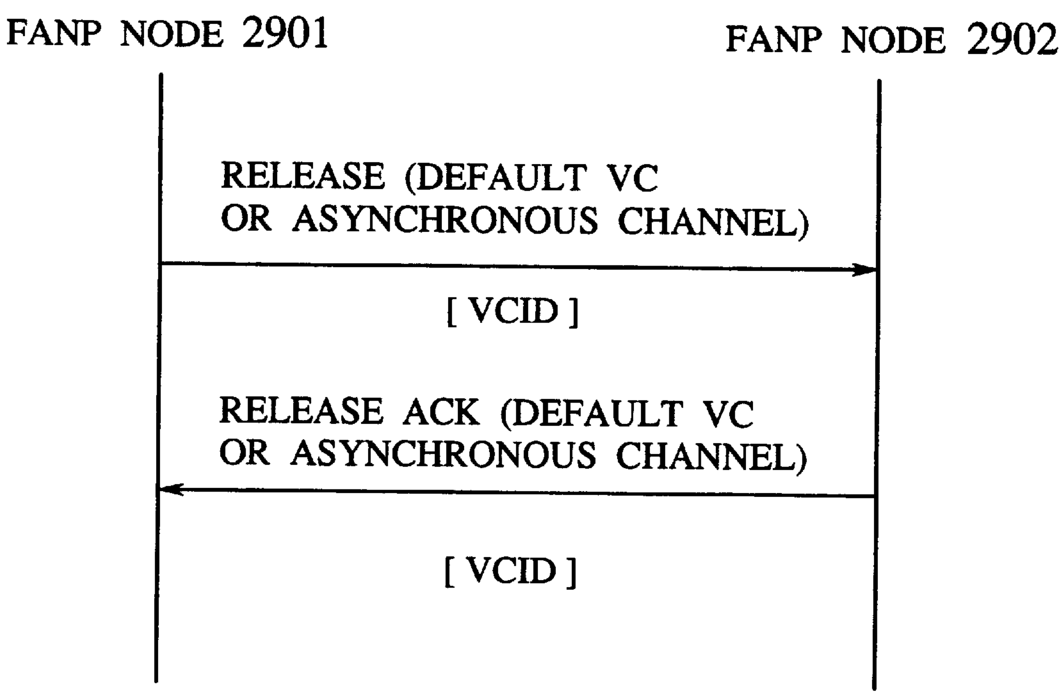

FANP NODE 2901
FANP NODE 2902
RELEASE (DEFAULT VC
OR ASYNCHRONOUS CHANNEL)
[VCID]
RELEASE ACK (DEFAULT VC
OR ASYNCHRONOUS CHANNEL)
[VCID]

FIG.30

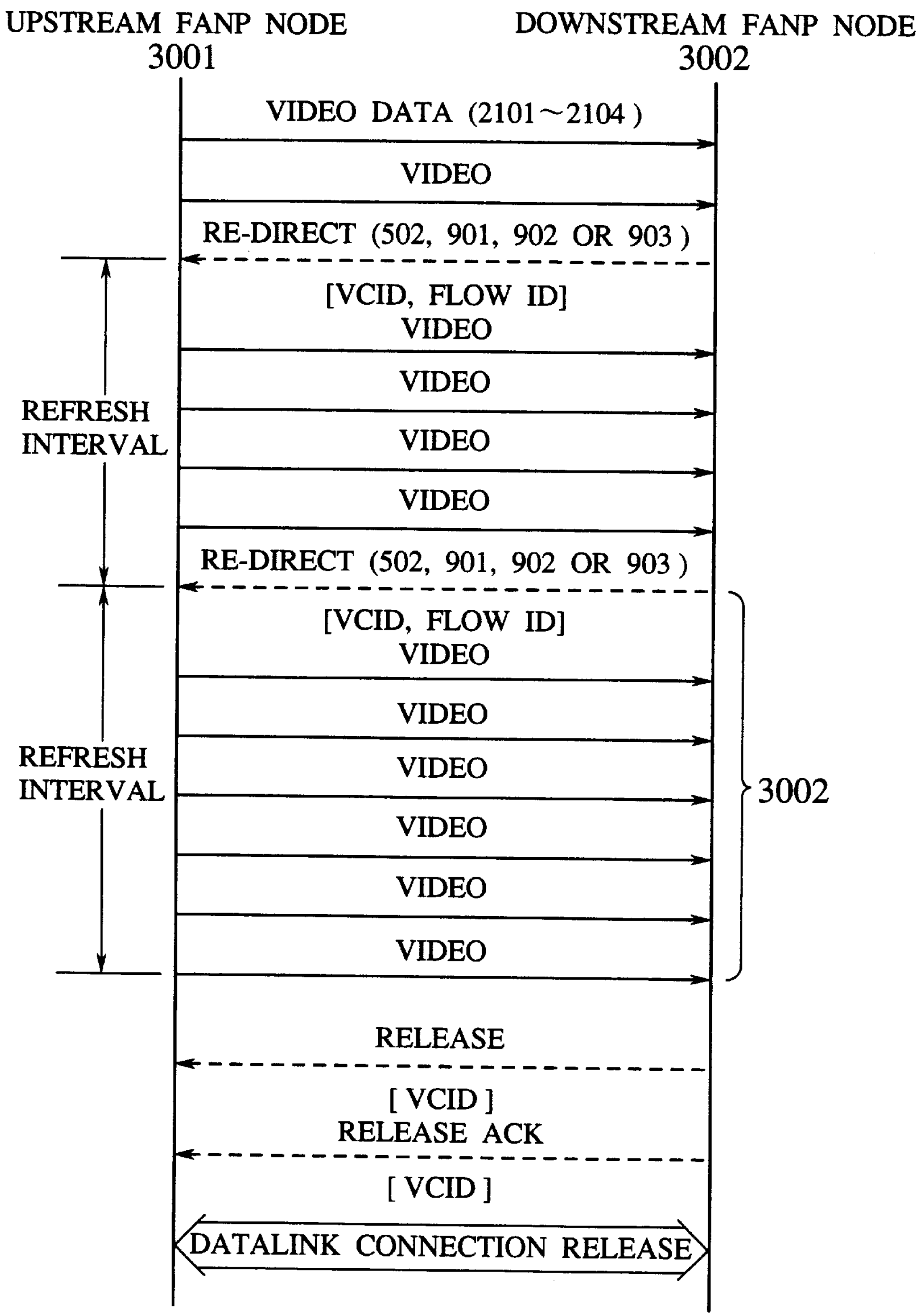

UPSTREAM FANP NODE
3001
DOWNSTREAM FANP NODE
3002
VIDEO DATA (2101~2104)
VIDEO
RE-DIRECT (502, 901, 902 OR 903)
[VCID, FLOW ID]
VIDEO
VIDEO
VIDEO
VIDEO
REFRESH INTERVAL
RE-DIRECT (502, 901, 902 OR 903)
[VCID, FLOW ID]
VIDEO
VIDEO
VIDEO
VIDEO
VIDEO
VIDEO
REFRESH INTERVAL
3002
RELEASE
[VCID]
RELEASE ACK
[VCID]
DATALINK CONNECTION RELEASE

FIG.31

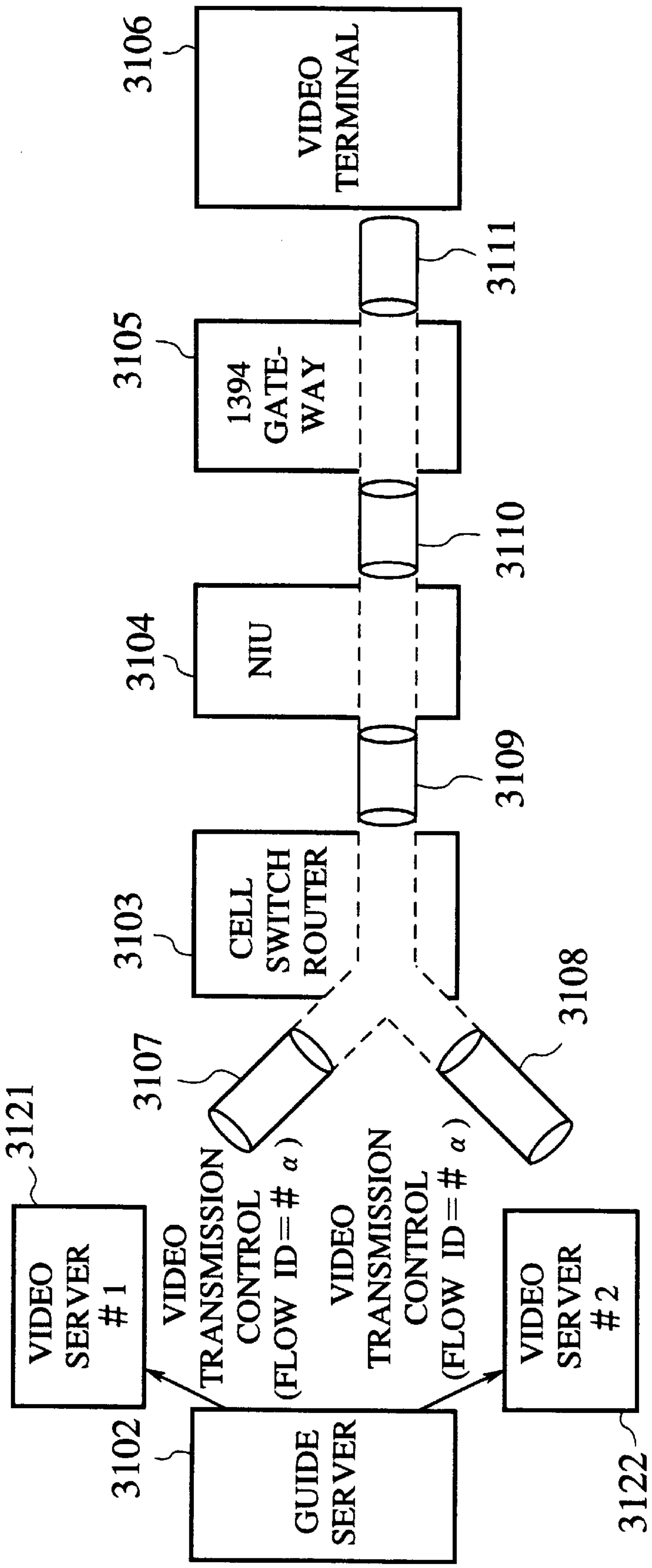

3106
VIDEO TERMINAL
3111
3105
1394 GATE-WAY
3110
3104
NIU
3109
3103
CELL SWITCH ROUTER
3107
3108
3121
VIDEO SERVER #1
VIDEO TRANSMISSION CONTROL (FLOW ID=#α)
VIDEO TRANSMISSION CONTROL (FLOW ID=#α)
VIDEO SERVER #2
3102
GUIDE SERVER
3122

FIG.32

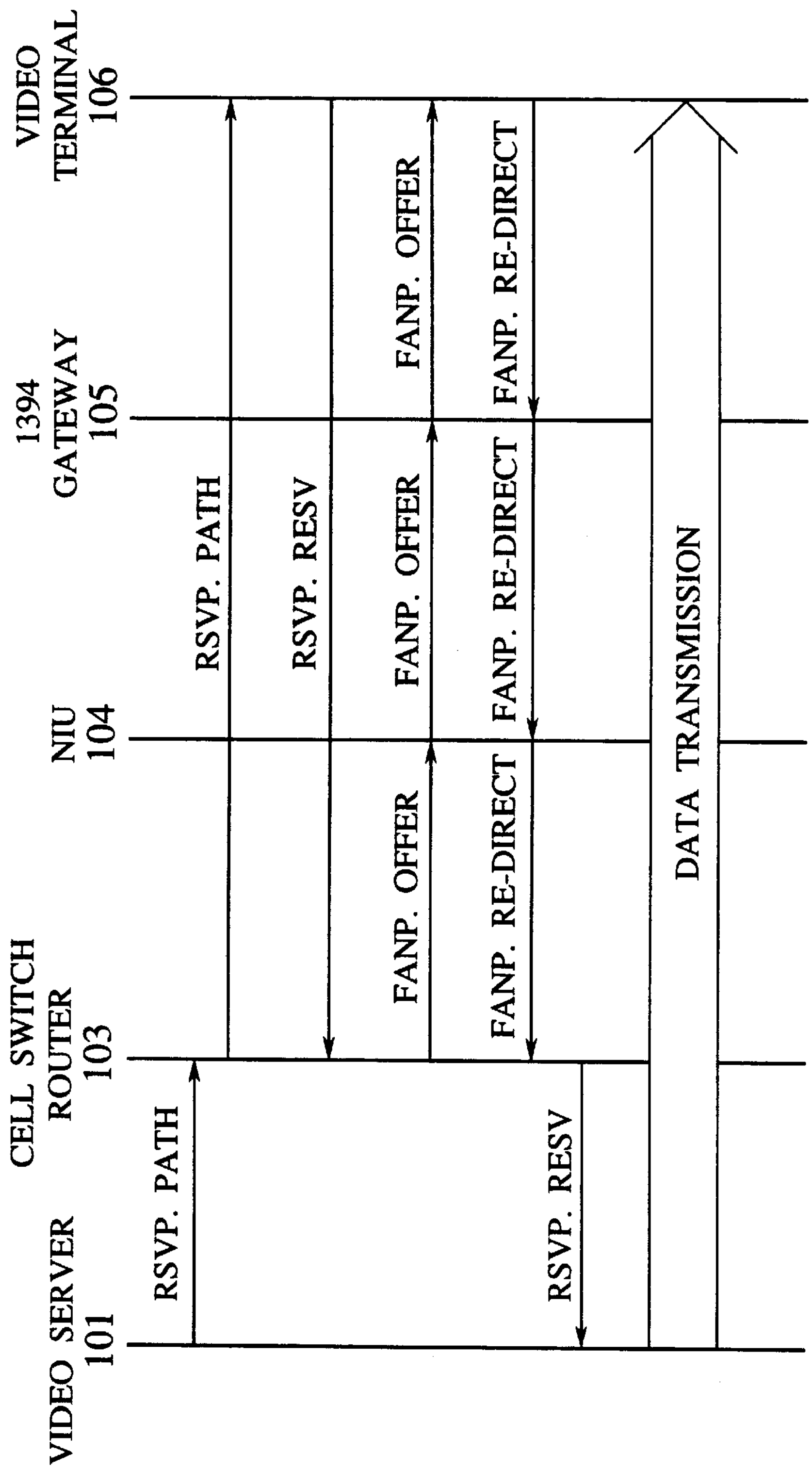
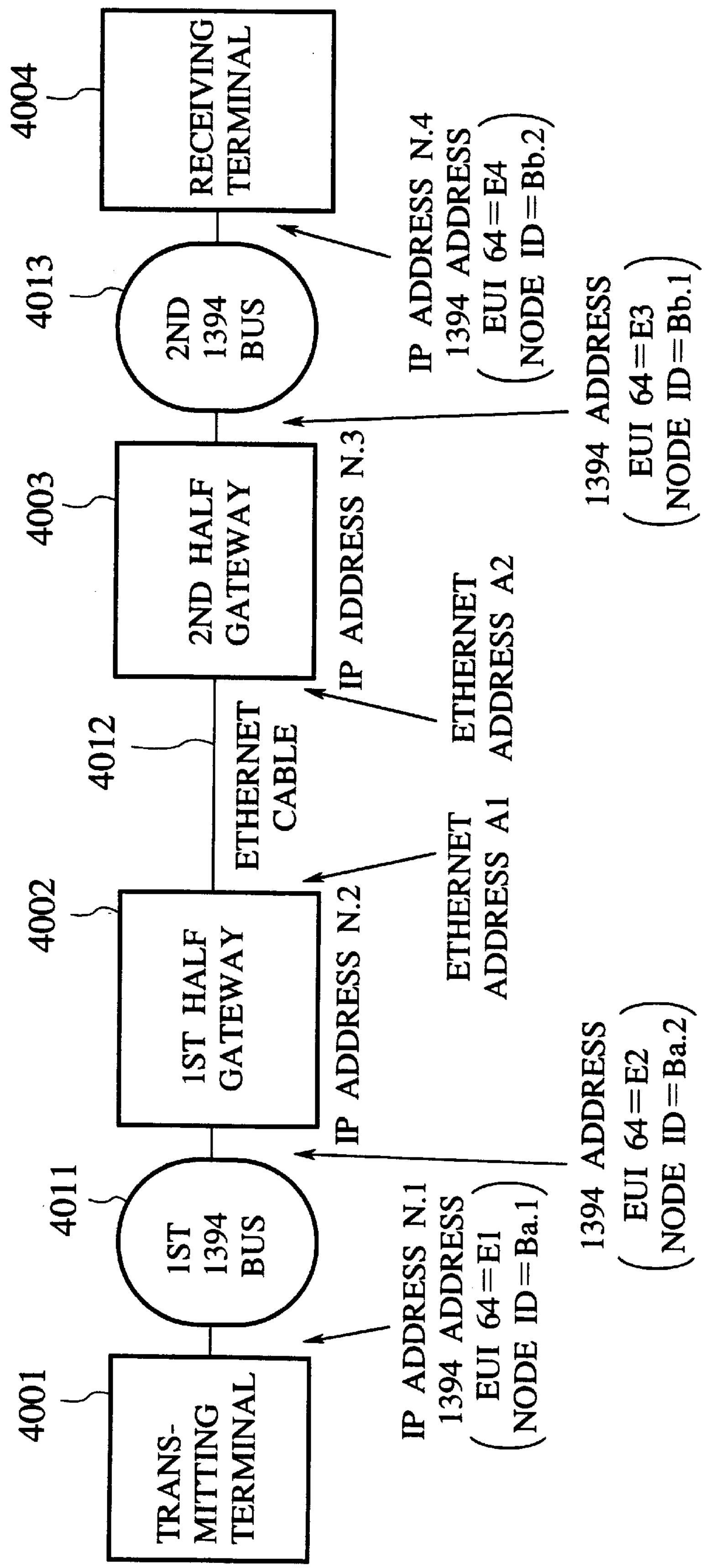

VIDEO SERVER 101
CELL SWITCH ROUTER 103
NIU 104
1394 GATEWAY 105
VIDEO TERMINAL 106
RSVP. PATH
RSVP. PATH
RSVP. RESV
FANP. OFFER
FANP. OFFER
FANP. OFFER
FANP. RE-DIRECT
FANP. RE-DIRECT
FANP. RE-DIRECT
RSVP. RESV
DATA TRANSMISSION

FIG.33



4001
TRANS-
MITTING
TERMINAL
4011
1ST
1394
BUS
4002
1ST HALF
GATEWAY
4012
ETHERNET
CABLE
4003
2ND HALF
GATEWAY
4013
2ND
1394
BUS
4004
RECEIVING
TERMINAL
IP ADDRESS N.1
1394 ADDRESS
(EUI 64=E1
NODE ID=Ba.1)
1394 ADDRESS
(EUI 64=E2
NODE ID=Ba.2)
IP ADDRESS N.2
ETHERNET
ADDRESS A1
ETHERNET
ADDRESS A2
IP ADDRESS N.3
1394 ADDRESS
(EUI 64=E3
NODE ID=Bb.1)
IP ADDRESS N.4
1394 ADDRESS
(EUI 64=E4
NODE ID=Bb.2)

FIG.34

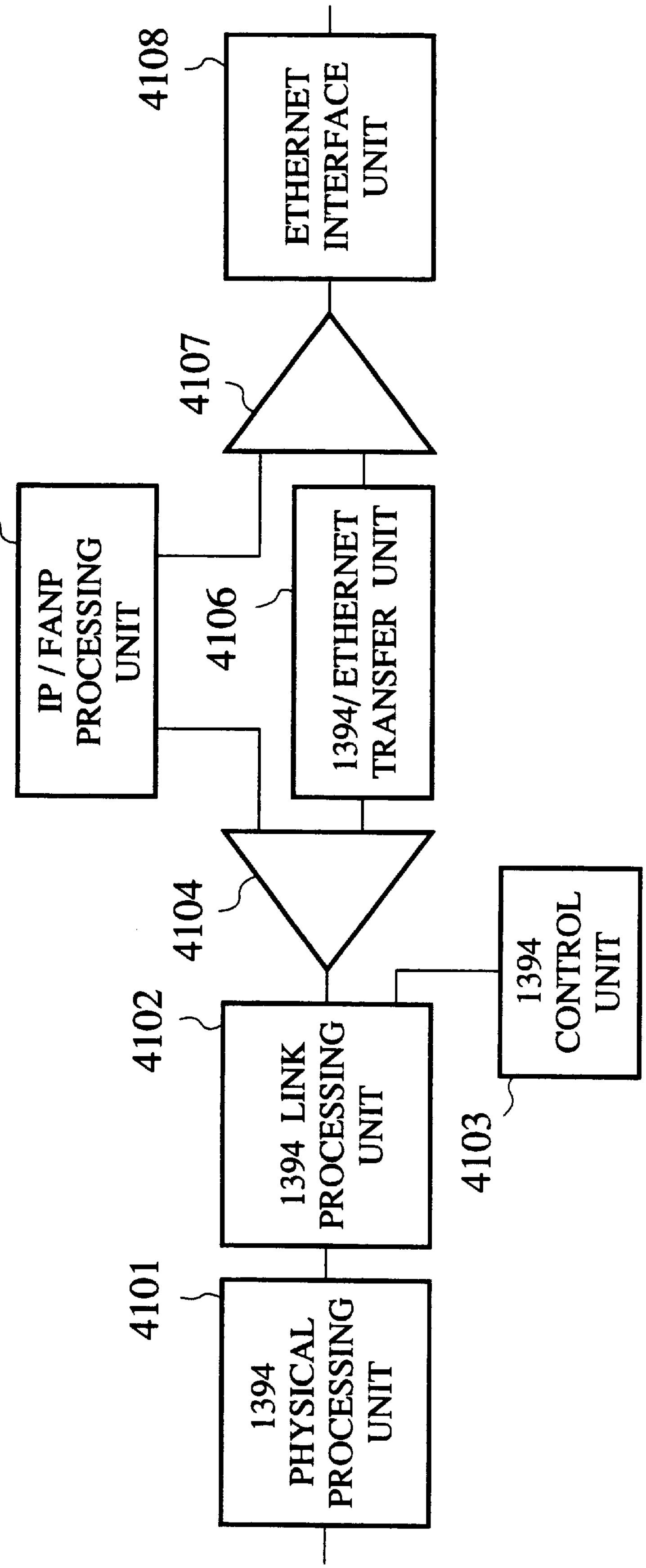

1394 PHYSICAL PROCESSING UNIT
4101
1394 LINK PROCESSING UNIT
4102
1394 CONTROL UNIT
4103
4104
IP / FANP PROCESSING UNIT
4105
1394/ ETHERNET TRANSFER UNIT
4106
4107
ETHERNET INTERFACE UNIT
4108

FIG.35

INPUT CHANNEL NO. OR DESTINATION ADDRESS WITH SPECIFIC REGISTER OFFSET	ATTRIBUTE	OUTPUT PORT	OUTPUT MAC ADDRESS
#1	MPEG, 4M	B	#A
#4	AUDIO, 1M	B	#B

FIG.36

INPUT MAC ADDRESS	ATTRIBUTE	OUTPUT PORT	OUTPUT CHANNEL NO. OR DESTINATION ADDRESS WITH SPECIFIC REGISTER OFFSET
# A	MPEG, 4M	B	# 1
# B	AUDIO, 1M	B	# 3

FIG.37

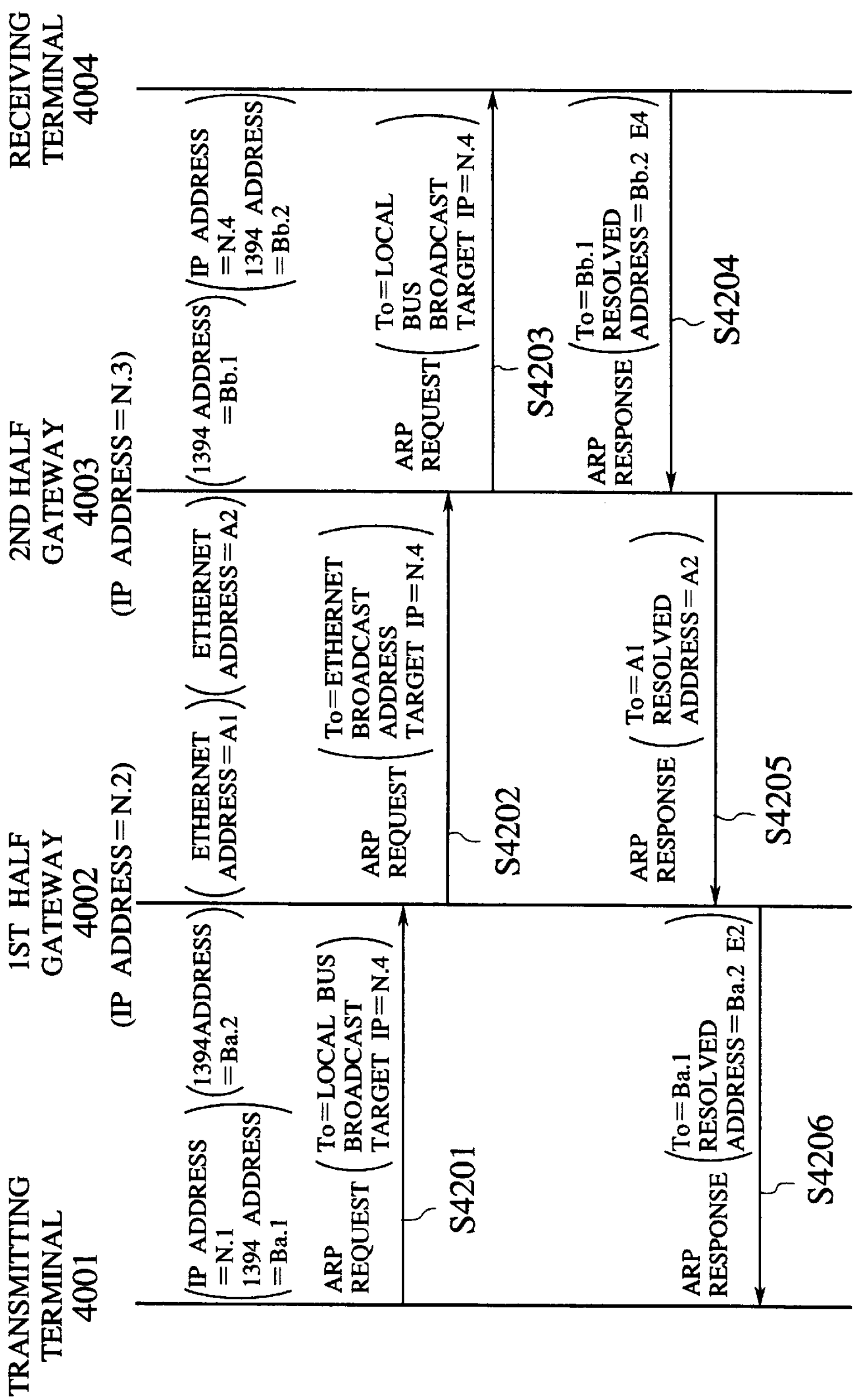

TRANSMITTING TERMINAL 4001
1ST HALF GATEWAY 4002 (IP ADDRESS=N.2)
2ND HALF GATEWAY 4003 (IP ADDRESS=N.3)
RECEIVING TERMINAL 4004
(IP ADDRESS =N.1 1394 ADDRESS =Ba.1)
(1394ADDRESS =Ba.2)
(ETHERNET ADDRESS=A1)
(ETHERNET ADDRESS=A2)
(1394 ADDRESS =Bb.1)
(IP ADDRESS =N.4 1394 ADDRESS =Bb.2)
ARP REQUEST (To=LOCAL BUS BROADCAST TARGET IP=N.4)
S4201
ARP REQUEST (To=ETHERNET BROADCAST ADDRESS TARGET IP=N.4)
S4202
ARP REQUEST (To=LOCAL BUS BROADCAST TARGET IP=N.4)
S4203
ARP RESPONSE (To=Bb.1 RESOLVED ADDRESS=Bb.2 E4)
S4204
ARP RESPONSE (To=A1 RESOLVED ADDRESS=A2)
S4205
ARP RESPONSE (To=Ba.1 RESOLVED ADDRESS=Ba.2 E2)
S4206

FIG.38

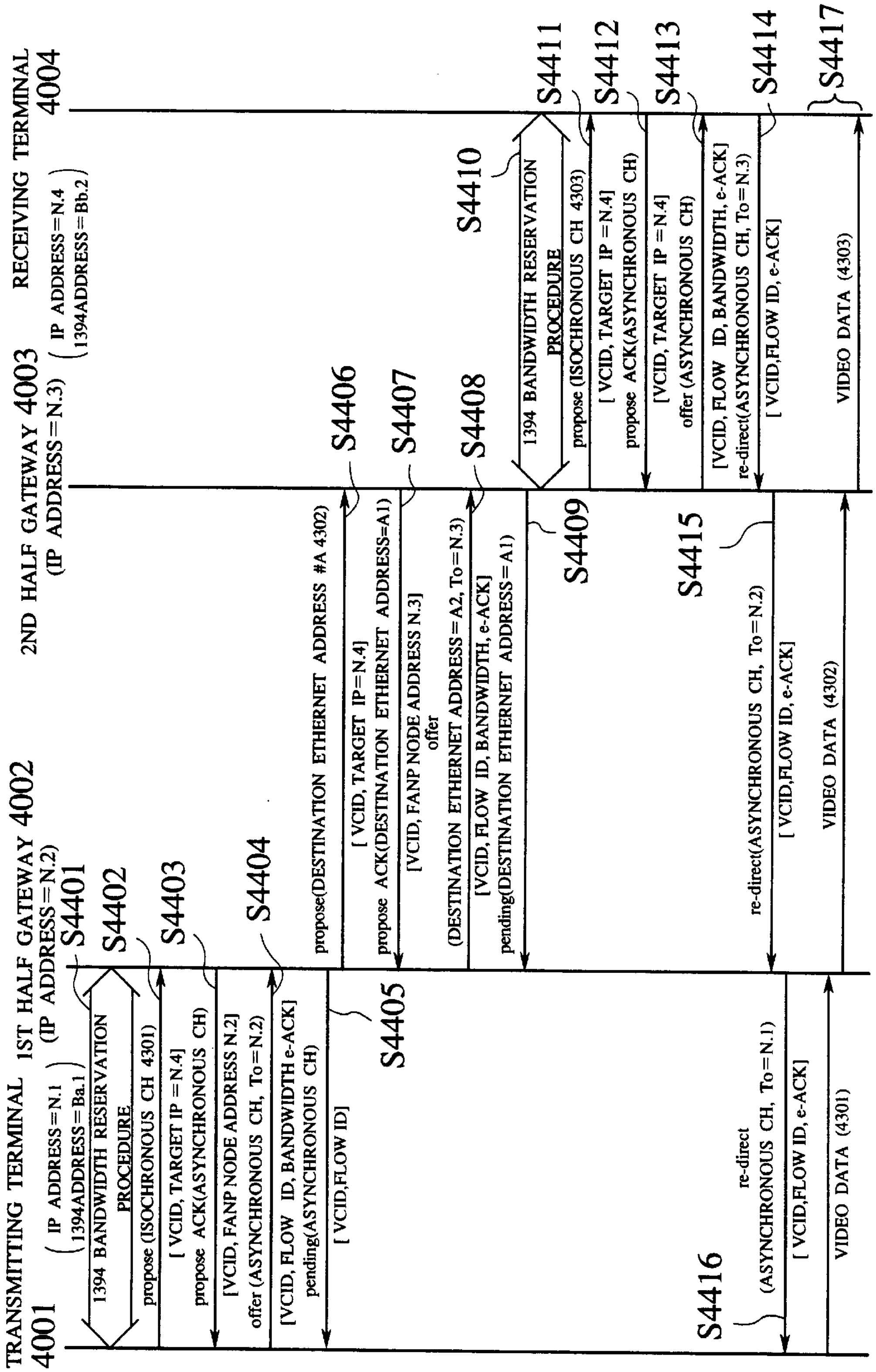

TRANSMITTING TERMINAL 4001
(IP ADDRESS=N.1
1394ADDRESS=Ba.1)
1ST HALF GATEWAY 4002
(IP ADDRESS=N.2)
2ND HALF GATEWAY 4003
(IP ADDRESS=N.3)
RECEIVING TERMINAL 4004
(IP ADDRESS=N.4
1394ADDRESS=Bb.2)
S4401
1394 BANDWIDTH RESERVATION PROCEDURE
S4402
propose (ISOCHRONOUS CH 4301)
S4403
[VCID, TARGET IP =N.4]
propose ACK(ASYNCHRONOUS CH)
[VCID, FANP NODE ADDRESS N.2]
offer (ASYNCHRONOUS CH, To=N.2)
S4404
[VCID, FLOW ID, BANDWIDTH e-ACK]
pending(ASYNCHRONOUS CH)
[VCID,FLOW ID]
S4405
propose(DESTINATION ETHERNET ADDRESS #A 4302)
S4406
[VCID, TARGET IP=N.4]
propose ACK(DESTINATION ETHERNET ADDRESS=A1)
S4407
[VCID, FANP NODE ADDRESS N.3]
offer
(DESTINATION ETHERNET ADDRESS=A2, To=N.3)
S4408
[VCID, FLOW ID, BANDWIDTH, e-ACK]
pending(DESTINATION ETHERNET ADDRESS=A1)
S4409
S4410
1394 BANDWIDTH RESERVATION PROCEDURE
propose (ISOCHRONOUS CH 4303)
S4411
[VCID, TARGET IP =N.4]
propose ACK(ASYNCHRONOUS CH)
S4412
[VCID, TARGET IP =N.4]
offer (ASYNCHRONOUS CH)
S4413
[VCID, FLOW ID, BANDWIDTH, e-ACK]
re-direct(ASYNCHRONOUS CH, To=N.3)
S4414
[VCID,FLOW ID, e-ACK]
VIDEO DATA (4303)
S4417
S4415
re-direct(ASYNCHRONOUS CH, To=N.2)
[VCID,FLOW ID, e-ACK]
VIDEO DATA (4302)
S4416
re-direct
(ASYNCHRONOUS CH, To=N.1)
[VCID,FLOW ID, e-ACK]
VIDEO DATA (4301)

FIG.39

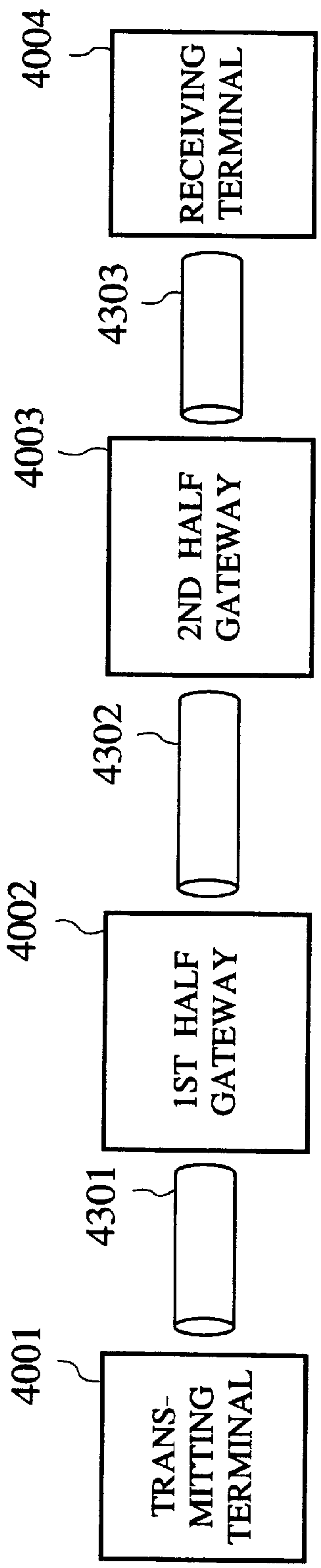
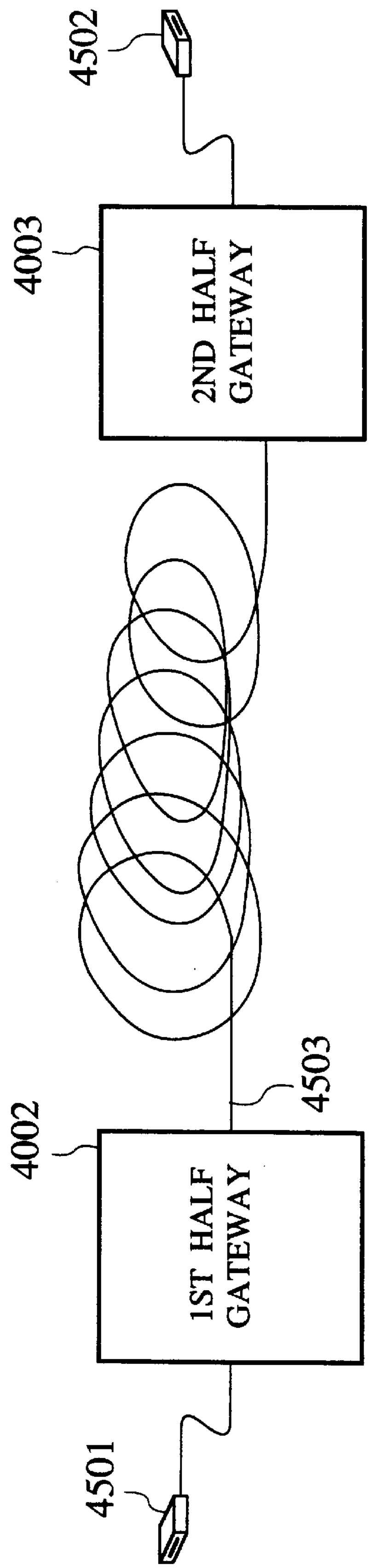

TRANS-
MITTING
TERMINAL
4001
4301
1ST HALF
GATEWAY
4002
4302
2ND HALF
GATEWAY
4003
4303
RECEIVING
TERMINAL
4004

FIG.40



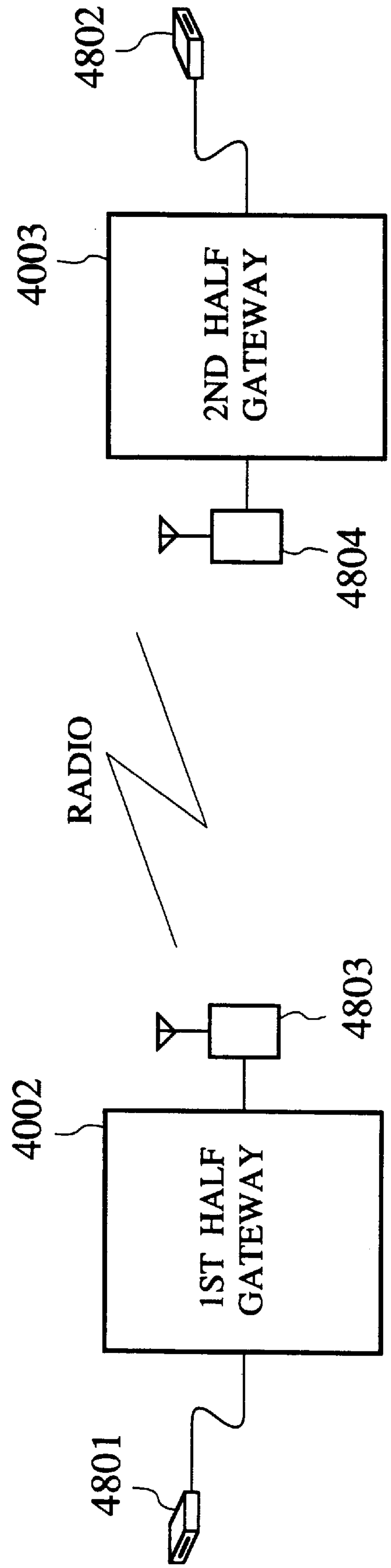
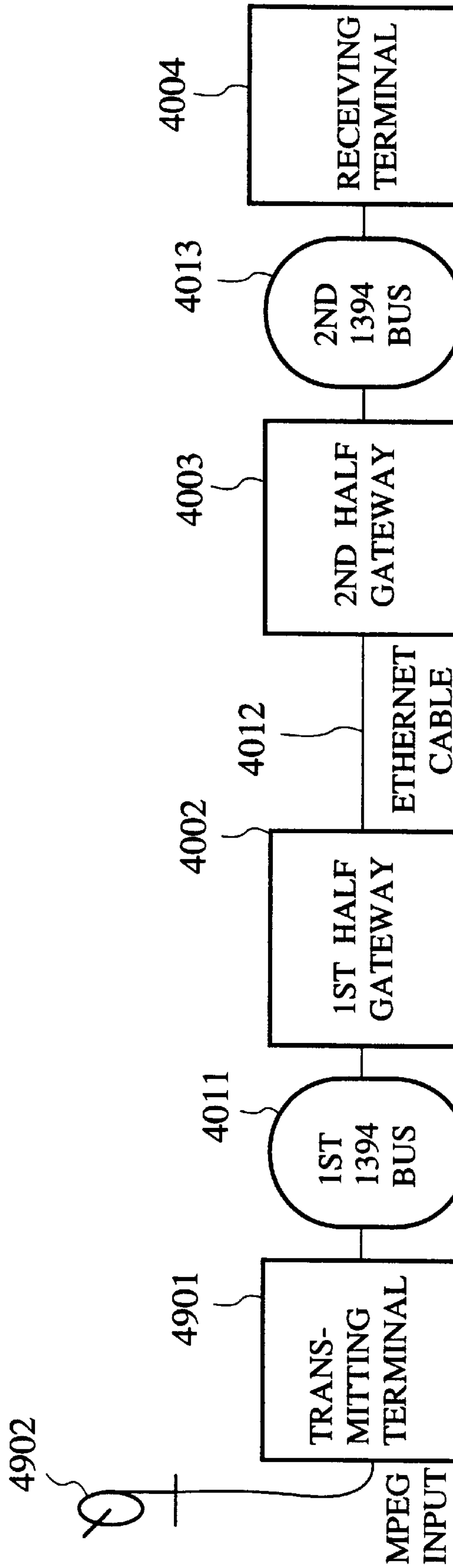

4802
4003
2ND HALF GATEWAY
4804
RADIO
4803
4002
1ST HALF GATEWAY
4801

FIG.41

FIG.42



4902
MPEG INPUT
4901
TRANS-MITTING TERMINAL
4011
1ST 1394 BUS
4002
1ST HALF GATEWAY
4012
ETHERNET CABLE
4003
2ND HALF GATEWAY
4013
2ND 1394 BUS
4004
RECEIVING TERMINAL

FIG.43

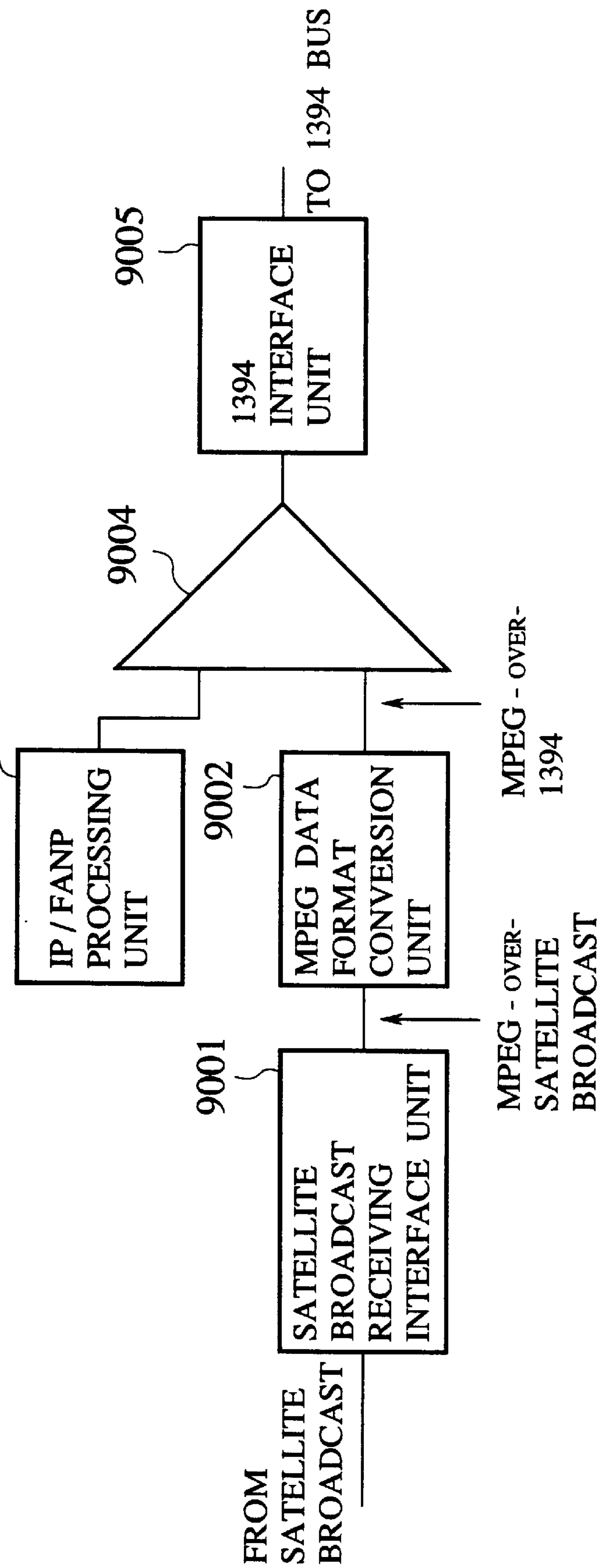

FROM SATELLITE BROADCAST
SATELLITE BROADCAST RECEIVING INTERFACE UNIT
9001
MPEG - OVER- SATELLITE BROADCAST
MPEG DATA FORMAT CONVERSION UNIT
9002
IP / FANP PROCESSING UNIT
9003
MPEG - OVER- 1394
9004
1394 INTERFACE UNIT
9005
TO 1394 BUS

FIG.44

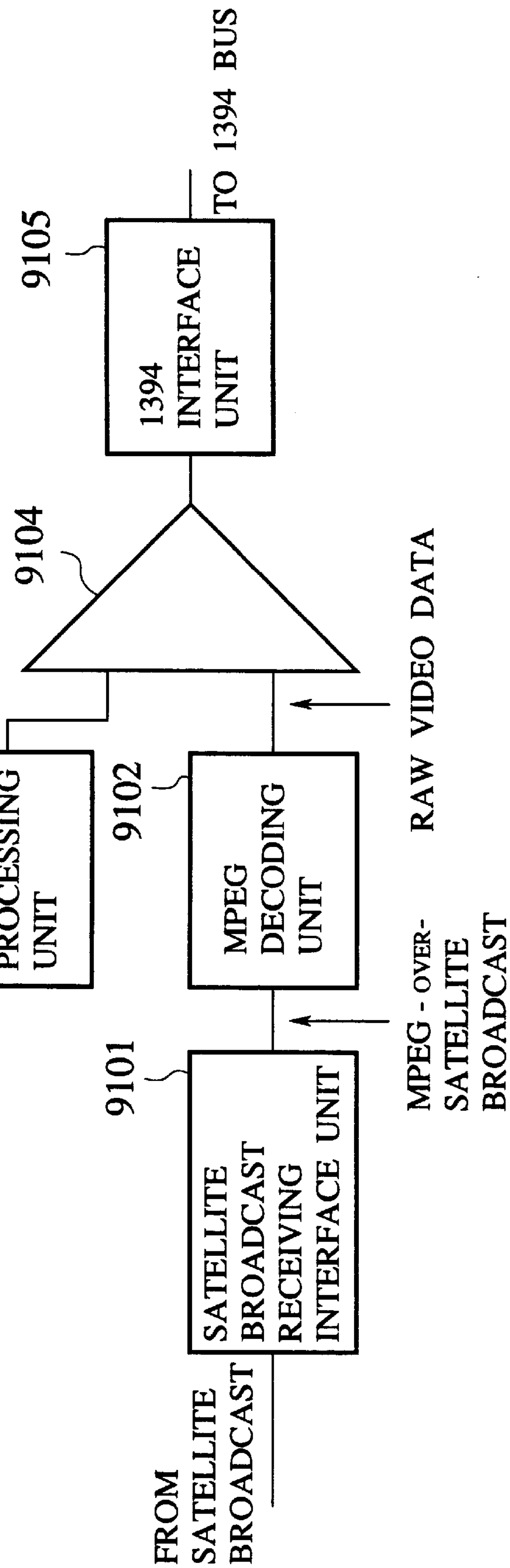

FROM SATELLITE BROADCAST
SATELLITE BROADCAST RECEIVING INTERFACE UNIT
9101
MPEG - OVER - SATELLITE BROADCAST
MPEG DECODING UNIT
9102
RAW VIDEO DATA
IP / FANP PROCESSING UNIT
9103
9104
1394 INTERFACE UNIT
9105
TO 1394 BUS

FIG.45

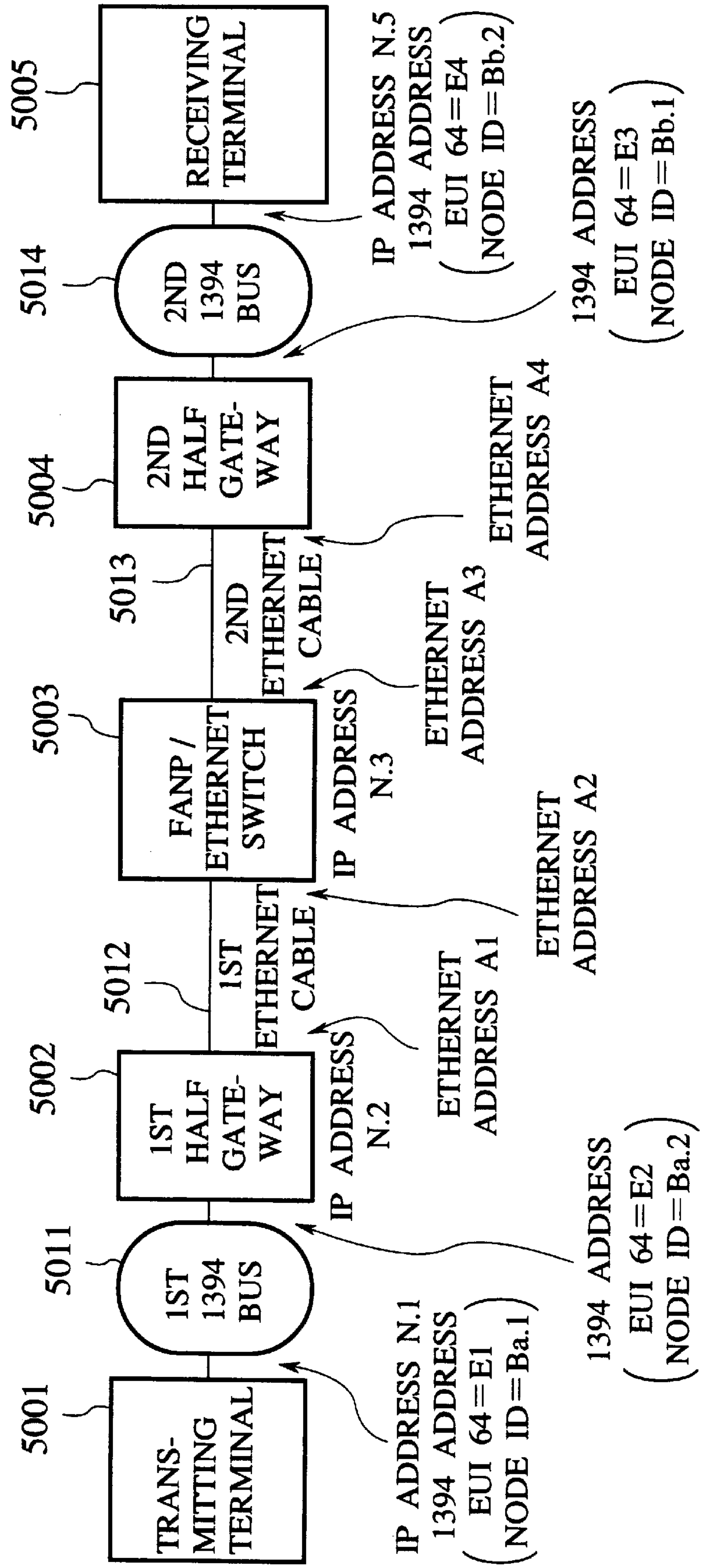

5001
TRANS-MITTING TERMINAL
5011
1ST 1394 BUS
5002
1ST HALF GATE-WAY
5012
1ST ETHERNET CABLE
5003
FANP / ETHERNET SWITCH
5013
2ND ETHERNET CABLE
5004
2ND HALF GATE-WAY
5014
2ND 1394 BUS
5005
RECEIVING TERMINAL
IP ADDRESS N.1
1394 ADDRESS
(EUI 64=E1
NODE ID=Ba.1)
1394 ADDRESS
(EUI 64=E2
NODE ID=Ba.2)
IP ADDRESS N.2
ETHERNET ADDRESS A1
ETHERNET ADDRESS A2
IP ADDRESS N.3
ETHERNET ADDRESS A3
ETHERNET ADDRESS A4
1394 ADDRESS
(EUI 64=E3
NODE ID=Bb.1)
IP ADDRESS N.5
1394 ADDRESS
(EUI 64=E4
NODE ID=Bb.2)

FIG.46

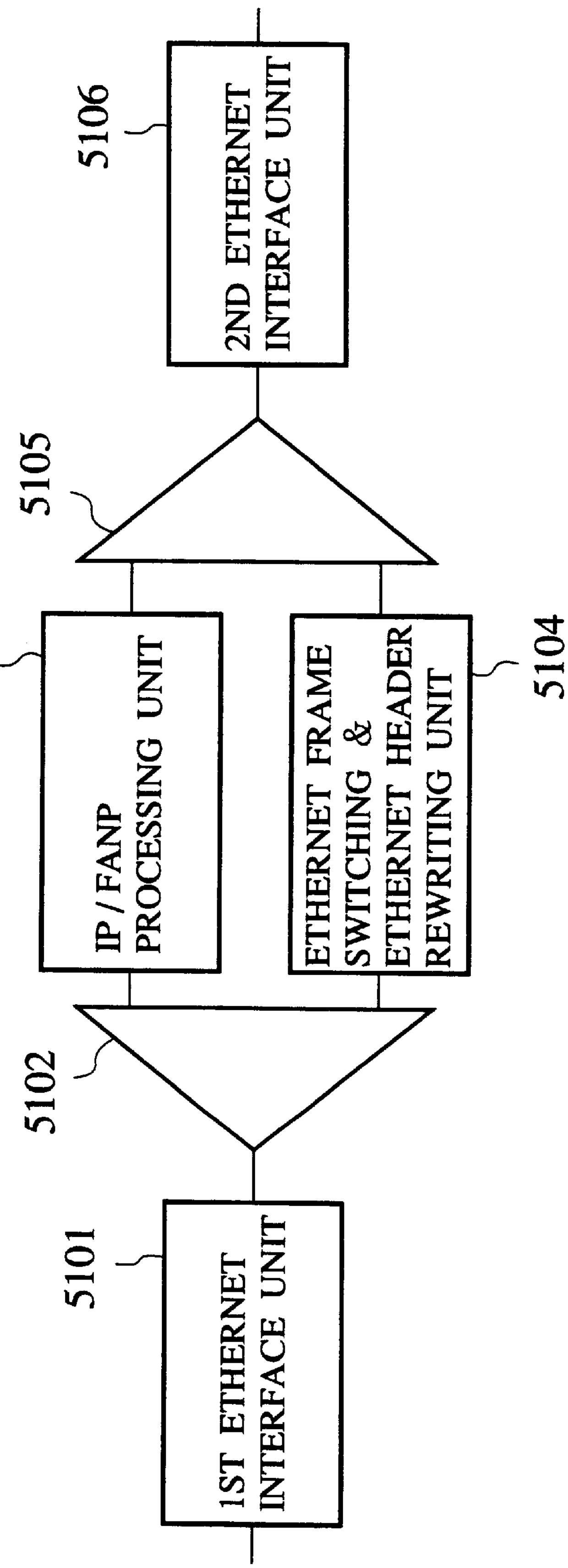

5101
1ST ETHERNET INTERFACE UNIT
5102
5103
IP / FANP PROCESSING UNIT
5104
ETHERNET FRAME SWITCHING & ETHERNET HEADER REWRITING UNIT
5105
5106
2ND ETHERNET INTERFACE UNIT

FIG.47

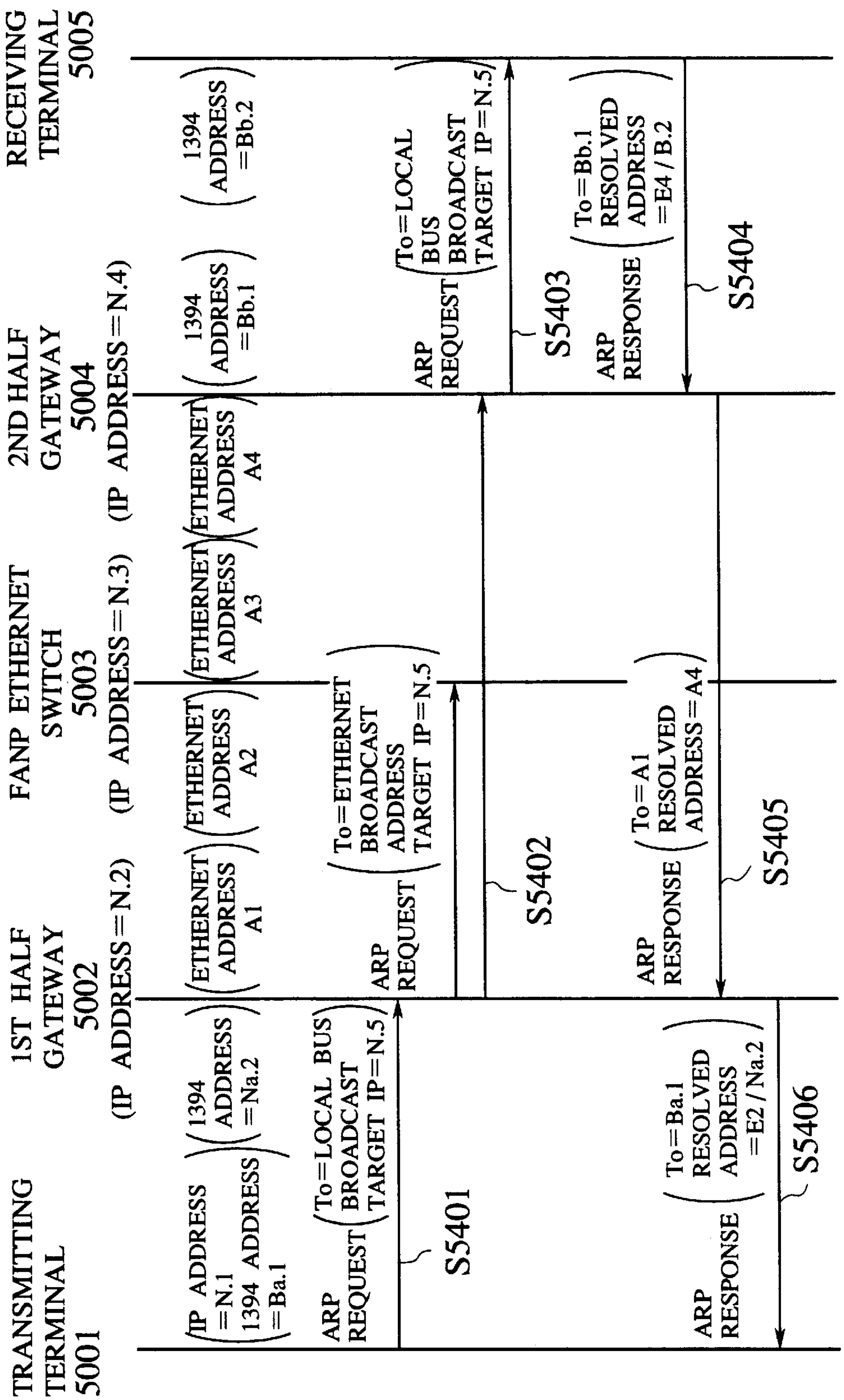

TRANSMITTING TERMINAL 5001
1ST HALF GATEWAY 5002 (IP ADDRESS=N.2)
FANP ETHERNET SWITCH 5003 (IP ADDRESS=N.3)
2ND HALF GATEWAY 5004 (IP ADDRESS=N.4)
RECEIVING TERMINAL 5005
(IP ADDRESS =N.1 1394 ADDRESS =Ba.1)
(1394 ADDRESS =Na.2)
(ETHERNET ADDRESS A1)
(ETHERNET ADDRESS A2)
(ETHERNET ADDRESS A3)
(ETHERNET ADDRESS A4)
(1394 ADDRESS =Bb.1)
(1394 ADDRESS =Bb.2)
ARP REQUEST (To=LOCAL BUS BROADCAST TARGET IP=N.5)
S5401
ARP REQUEST (To=ETHERNET BROADCAST ADDRESS TARGET IP=N.5)
S5402
ARP REQUEST (To=LOCAL BUS BROADCAST TARGET IP=N.5)
S5403
ARP RESPONSE (To=Bb.1 RESOLVED ADDRESS =E4 / B.2)
S5404
ARP RESPONSE (To=A1 RESOLVED ADDRESS=A4)
S5405
ARP RESPONSE (To=Ba.1 RESOLVED ADDRESS =E2 / Na.2)
S5406

FIG.48

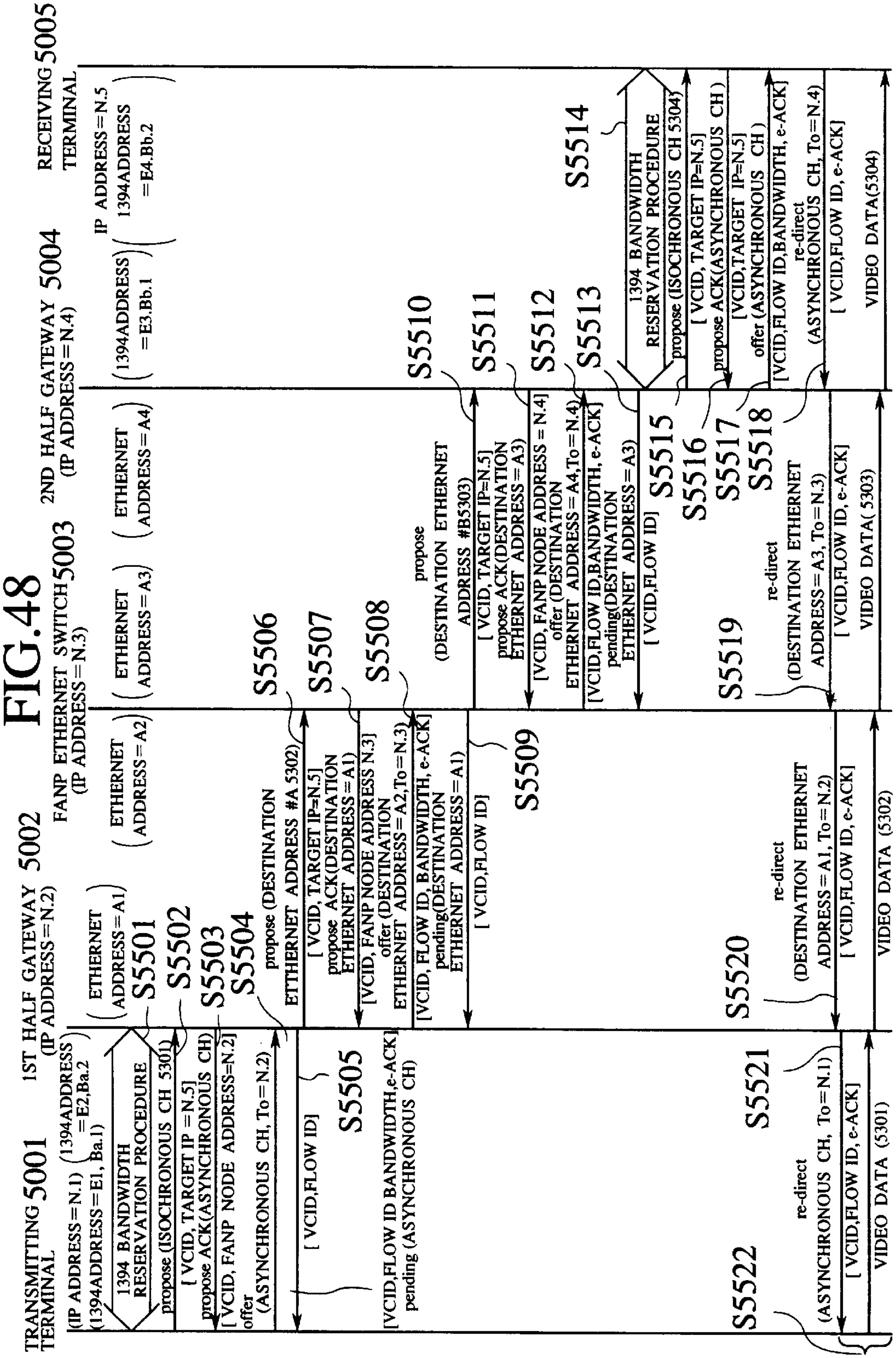
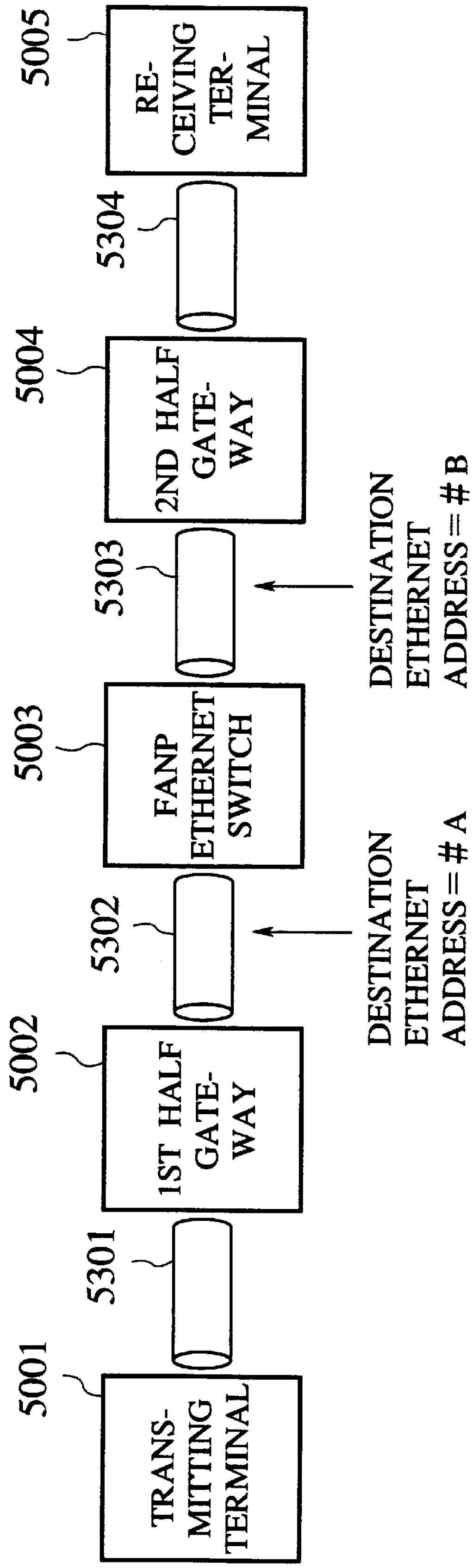

TRANSMITTING TERMINAL 5001
(IP ADDRESS=N.1)
(1394ADDRESS=E1, Ba.1)
(1394ADDRESS =E2,Ba.2)
1ST HALF GATEWAY 5002
(IP ADDRESS=N.2)
(ETHERNET ADDRESS=A1)
(ETHERNET ADDRESS=A2)
FANP ETHERNET SWITCH 5003
(IP ADDRESS=N.3)
(ETHERNET ADDRESS=A3)
(ETHERNET ADDRESS=A4)
2ND HALF GATEWAY 5004
(IP ADDRESS=N.4)
(1394ADDRESS =E3.Bb.1)
RECEIVING TERMINAL 5005
IP ADDRESS=N.5
(1394ADDRESS =E4.Bb.2)
1394 BANDWIDTH RESERVATION PROCEDURE
S5501
propose (ISOCHRONOUS CH 5301)
S5502
[VCID, TARGET IP =N.5]
propose ACK(ASYNCHRONOUS CH)
S5503
[VCID, FANP NODE ADDRESS=N.2]
offer
(ASYNCHRONOUS CH, To=N.2)
S5504
propose (DESTINATION ETHERNET ADDRESS #A 5302)
[VCID,FLOW ID]
S5505
[VCID,FLOW ID BANDWIDTH,e-ACK]
pending (ASYNCHRONOUS CH)
S5506
[VCID, TARGET IP=N.5]
propose ACK(DESTINATION ETHERNET ADDRESS=A1)
S5507
[VCID, FANP NODE ADDRESS N.3]
offer (DESTINATION ETHERNET ADDRESS=A2,To=N.3)
S5508
[VCID, FLOW ID, BANDWIDTH, e-ACK]
pending(DESTINATION ETHERNET ADDRESS=A1)
[VCID,FLOW ID]
S5509
propose
(DESTINATION ETHERNET ADDRESS #B5303)
S5510
[VCID, TARGET IP=N.5]
propose ACK(DESTINATION ETHERNET ADDRESS=A3)
S5511
[VCID, FANP NODE ADDRESS =N.4]
offer (DESTINATION ETHERNET ADDRESS=A4,To=N.4)
S5512
[VCID,FLOW ID,BANDWIDTH, e-ACK]
pending(DESTINATION ETHERNET ADDRESS=A3)
S5513
[VCID,FLOW ID]
1394 BANDWIDTH RESERVATION PROCEDURE
S5514
propose (ISOCHRONOUS CH 5304)
S5515
[VCID, TARGET IP=N.5]
propose ACK(ASYNCHRONOUS CH)
S5516
[VCID,TARGET IP=N.5]
offer (ASYNCHRONOUS CH)
S5517
[VCID,FLOW ID,BANDWIDTH, e-ACK]
re-direct
(ASYNCHRONOUS CH, To=N.4)
S5518
[VCID,FLOW ID, e-ACK]
VIDEO DATA(5304)
S5519
re-direct
(DESTINATION ETHERNET ADDRESS=A3, To=N.3)
[VCID,FLOW ID, e-ACK]
VIDEO DATA(5303)
S5520
re-direct
(DESTINATION ETHERNET ADDRESS=A1, To=N.2)
[VCID,FLOW ID, e-ACK]
VIDEO DATA (5302)
S5521
re-direct
(ASYNCHRONOUS CH, To=N.1)
S5522
[VCID,FLOW ID, e-ACK]
VIDEO DATA (5301)

FIG.49



TRANS-MITTING TERMINAL
5001
5301
1ST HALF GATE-WAY
5002
5302
DESTINATION ETHERNET ADDRESS=#A
FANP ETHERNET SWITCH
5003
5303
DESTINATION ETHERNET ADDRESS=#B
2ND HALF GATE-WAY
5004
5304
RE-CEIVING TER-MINAL
5005

FIG.50

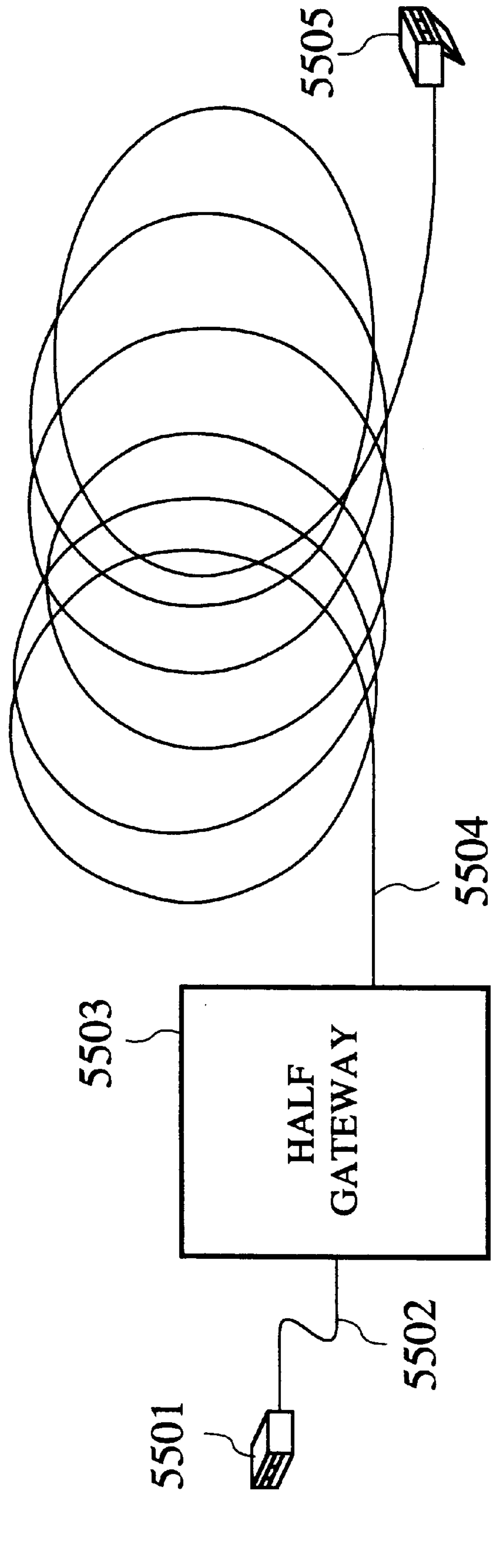


FIG.51

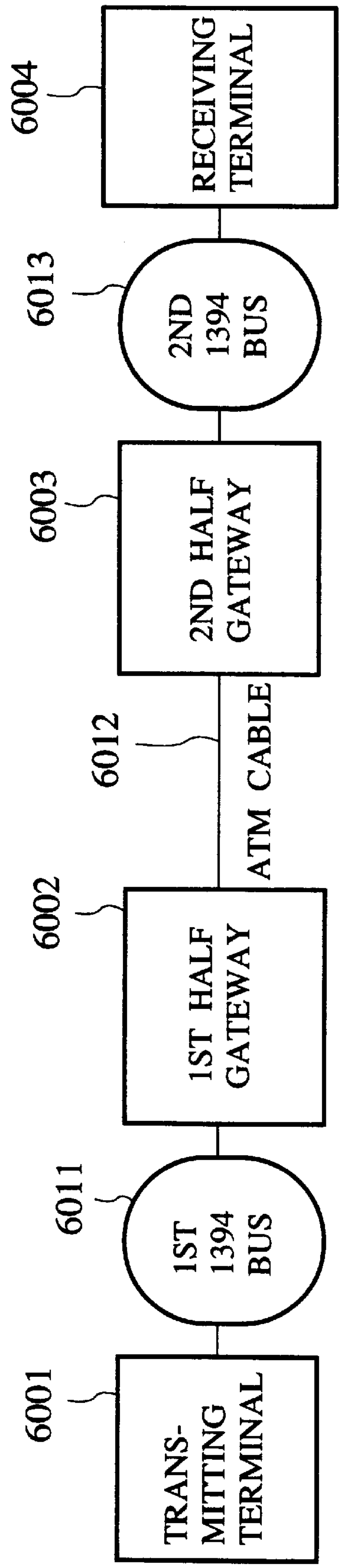

6001
TRANS-
MITTING
TERMINAL
6011
1ST
1394
BUS
6002
1ST HALF
GATEWAY
6012
ATM CABLE
6003
2ND HALF
GATEWAY
6013
2ND
1394
BUS
6004
RECEIVING
TERMINAL

FIG.52

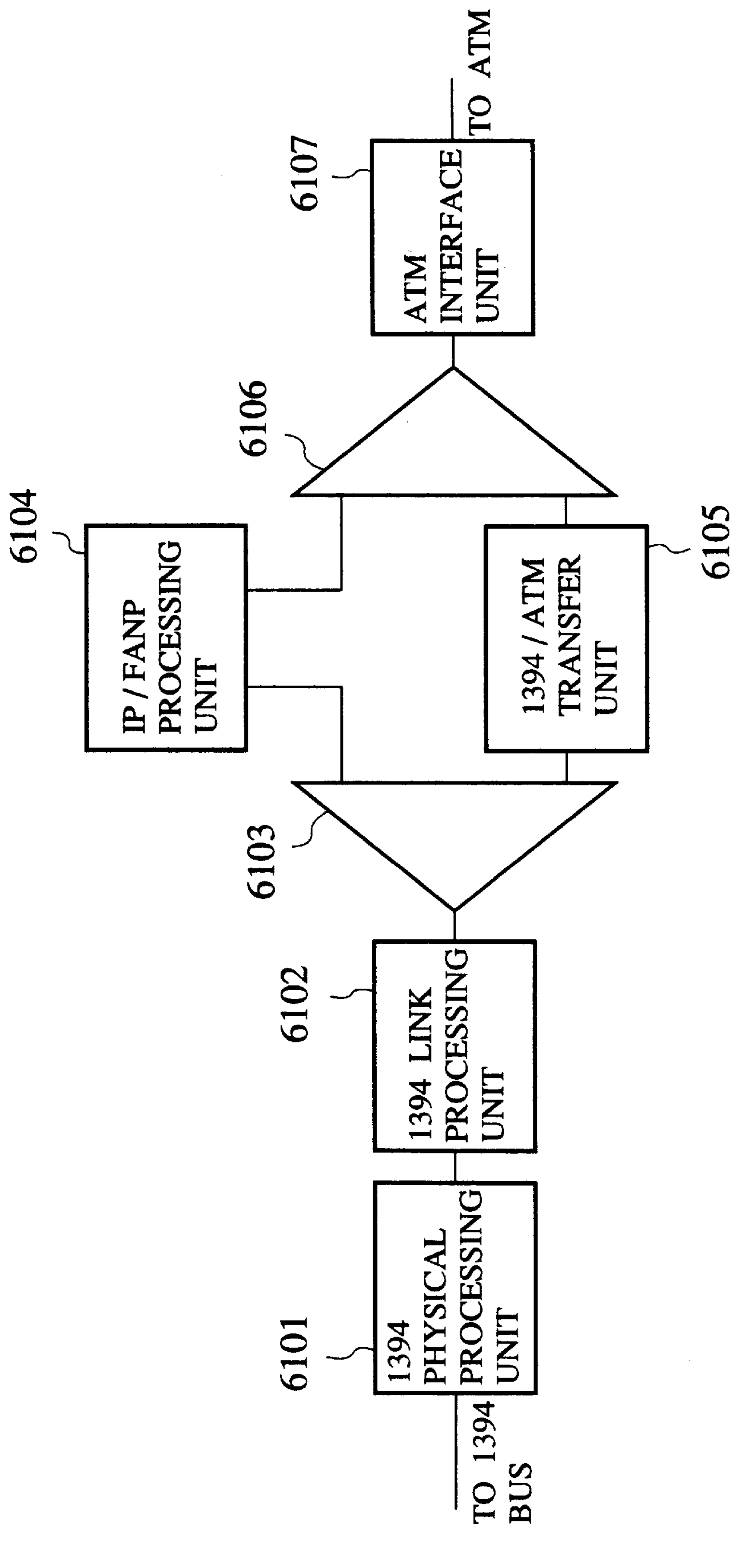

TO 1394 BUS
6101
1394 PHYSICAL PROCESSING UNIT
6102
1394 LINK PROCESSING UNIT
6103
6104
IP / FANP PROCESSING UNIT
6105
1394 / ATM TRANSFER UNIT
6106
6107
ATM INTERFACE UNIT
TO ATM

FIG.53

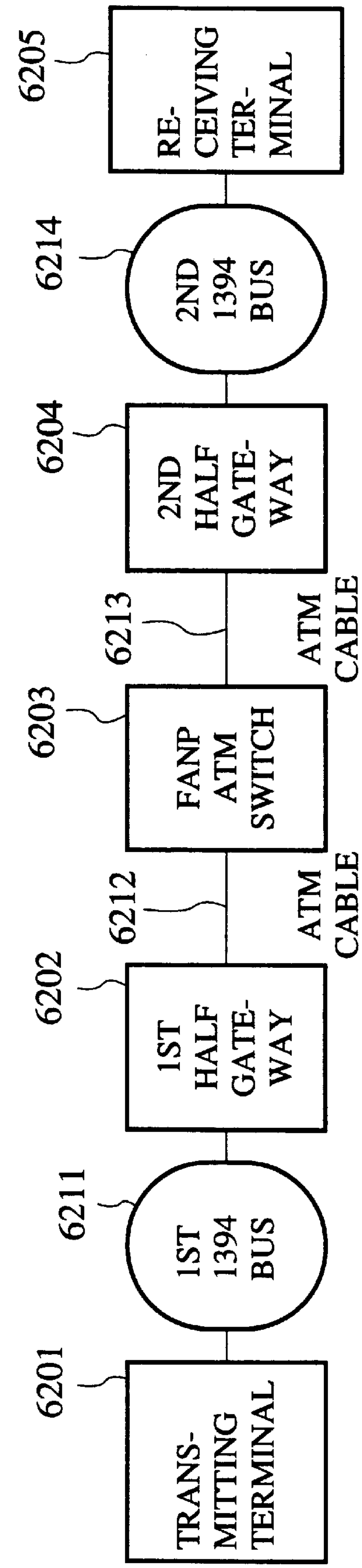

TRANS-
MITTING
TERMINAL
6201
1ST
1394
BUS
6211
1ST
HALF
GATE-
WAY
6202
6212
ATM
CABLE
FANP
ATM
SWITCH
6203
6213
ATM
CABLE
2ND
HALF
GATE-
WAY
6204
2ND
1394
BUS
6214
RE-
CEIVING
TER-
MINAL
6205

FIG.54

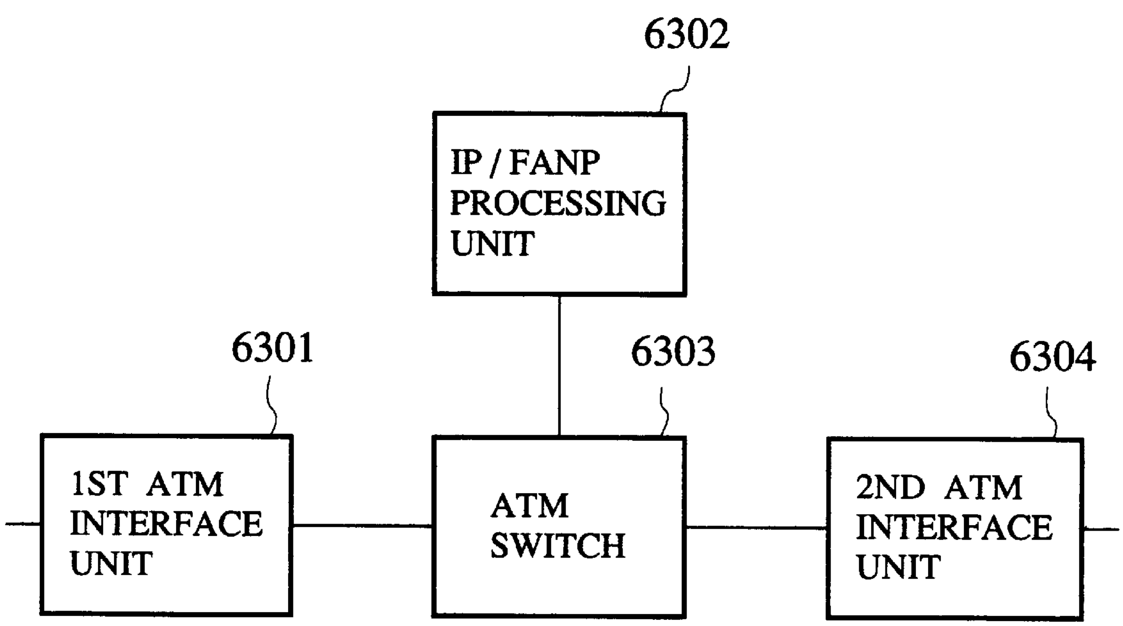

6302
IP / FANP
PROCESSING
UNIT
6301
6303
6304
1ST ATM
INTERFACE
UNIT
ATM
SWITCH
2ND ATM
INTERFACE
UNIT

FIG.55

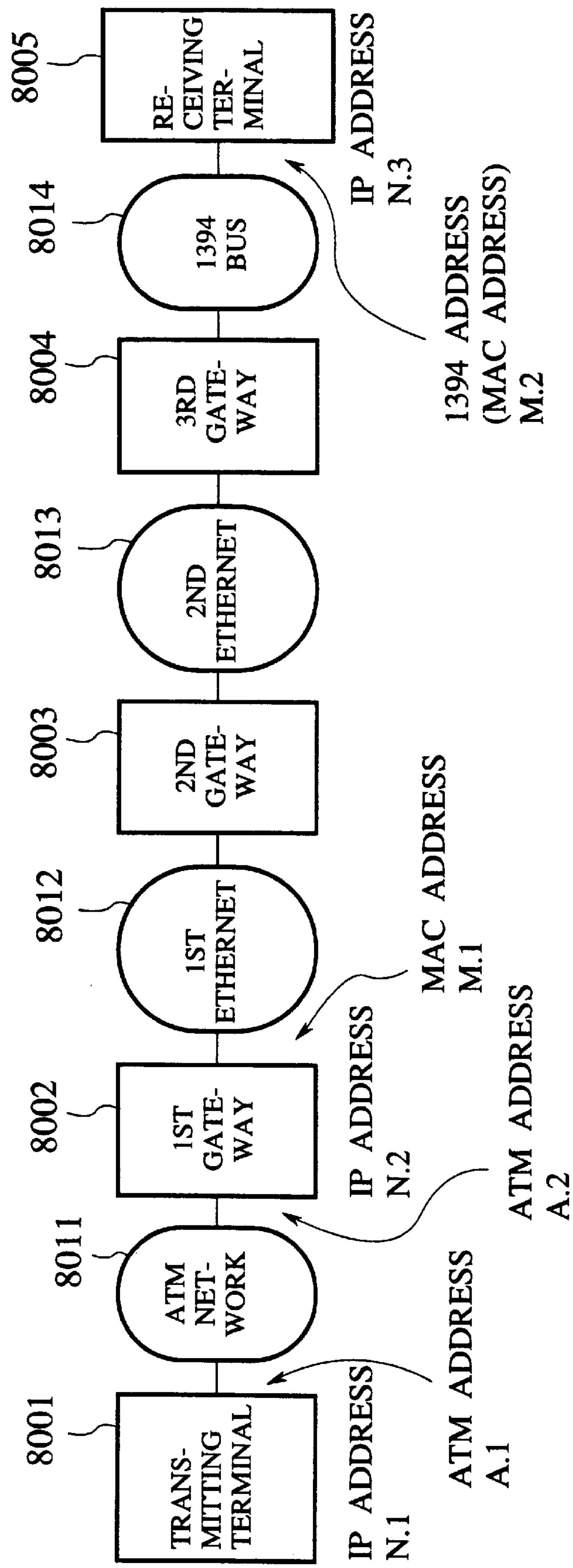
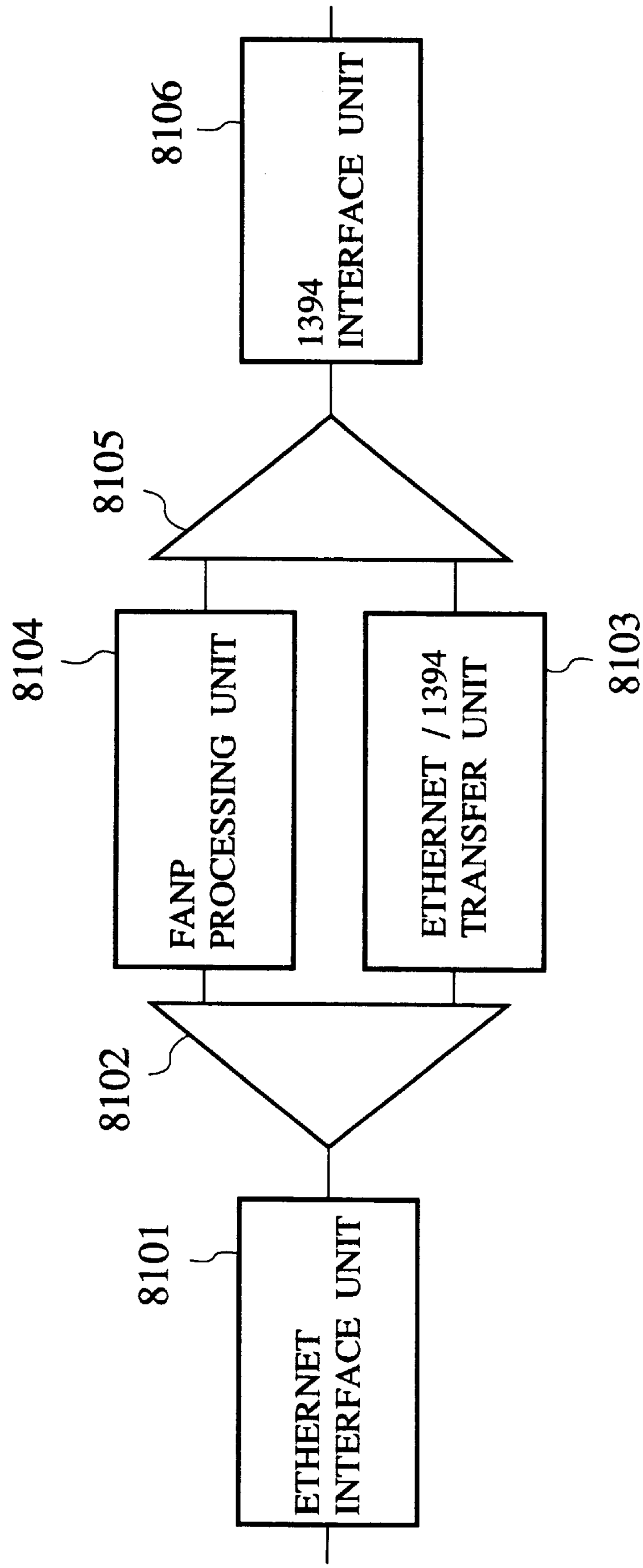

8001
TRANS-MITTING TERMINAL
IP ADDRESS N.1
8011
ATM NET-WORK
ATM ADDRESS A.1
8002
1ST GATE-WAY
IP ADDRESS N.2
ATM ADDRESS A.2
8012
1ST ETHERNET
MAC ADDRESS M.1
8003
2ND GATE-WAY
8013
2ND ETHERNET
8004
3RD GATE-WAY
8014
1394 BUS
1394 ADDRESS (MAC ADDRESS) M.2
8005
RE-CEIVING TER-MINAL
IP ADDRESS N.3

FIG.56


ETHERNET
INTERFACE UNIT
8101
8102
FANP
PROCESSING UNIT
8104
ETHERNET / 1394
TRANSFER UNIT
8103
8105
1394
INTERFACE UNIT
8106

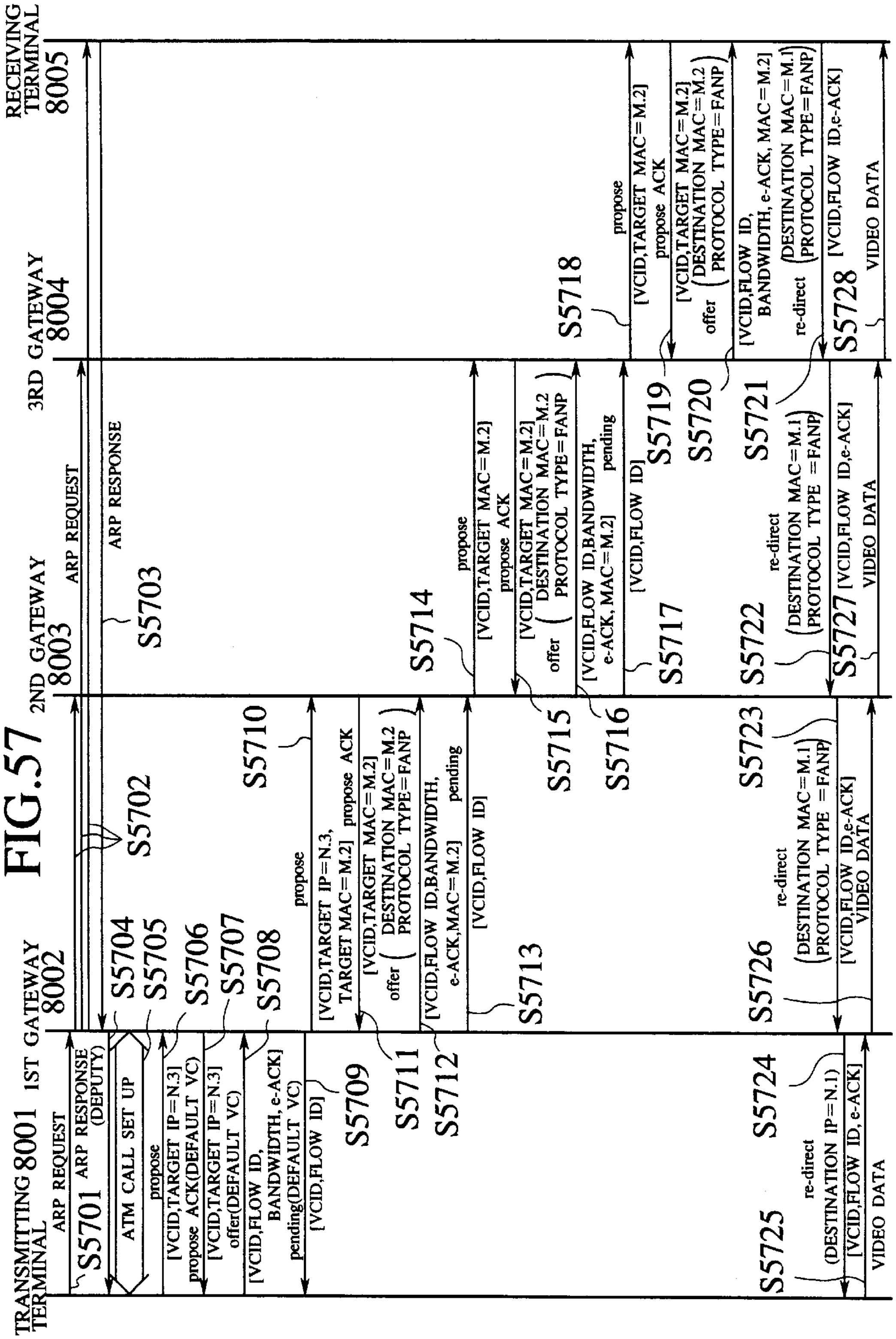

TRANSMITTING TERMINAL 8001
1ST GATEWAY 8002
2ND GATEWAY 8003
3RD GATEWAY 8004
RECEIVING TERMINAL 8005
S5701
ARP REQUEST
ARP RESPONSE (DEPUTY)
S5702
S5703
ARP REQUEST
ARP RESPONSE
ATM CALL SET UP
S5704
S5705
S5706
S5707
S5708
propose
[VCID,TARGET IP=N.3]
propose ACK(DEFAULT VC)
[VCID,TARGET IP=N.3]
offer(DEFAULT VC)
[VCID,FLOW ID, BANDWIDTH, e-ACK]
pending(DEFAULT VC)
[VCID,FLOW ID]
S5709
S5710
propose
[VCID,TARGET IP=N.3, TARGET MAC=M.2]
propose ACK
[VCID,TARGET MAC=M.2]
offer (DESTINATION MAC=M.2 PROTOCOL TYPE=FANP)
S5711
[VCID,FLOW ID,BANDWIDTH, e-ACK,MAC=M.2]
pending
S5712
[VCID,FLOW ID]
S5713
S5714
propose
[VCID,TARGET MAC=M.2]
propose ACK
[VCID,TARGET MAC=M.2]
offer (DESTINATION MAC=M.2 PROTOCOL TYPE=FANP)
S5715
[VCID,FLOW ID,BANDWIDTH, e-ACK, MAC=M.2]
pending
S5716
[VCID,FLOW ID]
S5717
S5718
propose
[VCID,TARGET MAC=M.2]
propose ACK
S5719
[VCID,TARGET MAC=M.2]
offer (DESTINATION MAC=M.2 PROTOCOL TYPE=FANP)
S5720
[VCID,FLOW ID, BANDWIDTH, e-ACK, MAC=M.2]
re-direct (DESTINATION MAC=M.1 PROTOCOL TYPE=FANP)
S5721
S5722
re-direct (DESTINATION MAC=M.1 PROTOCOL TYPE =FANP)
S5723
S5726
re-direct (DESTINATION MAC=M.1 PROTOCOL TYPE =FANP)
S5724
S5725
re-direct (DESTINATION IP=N.1)
[VCID,FLOW ID, e-ACK]
VIDEO DATA
S5727
S5728

FIG.57

FIG.58

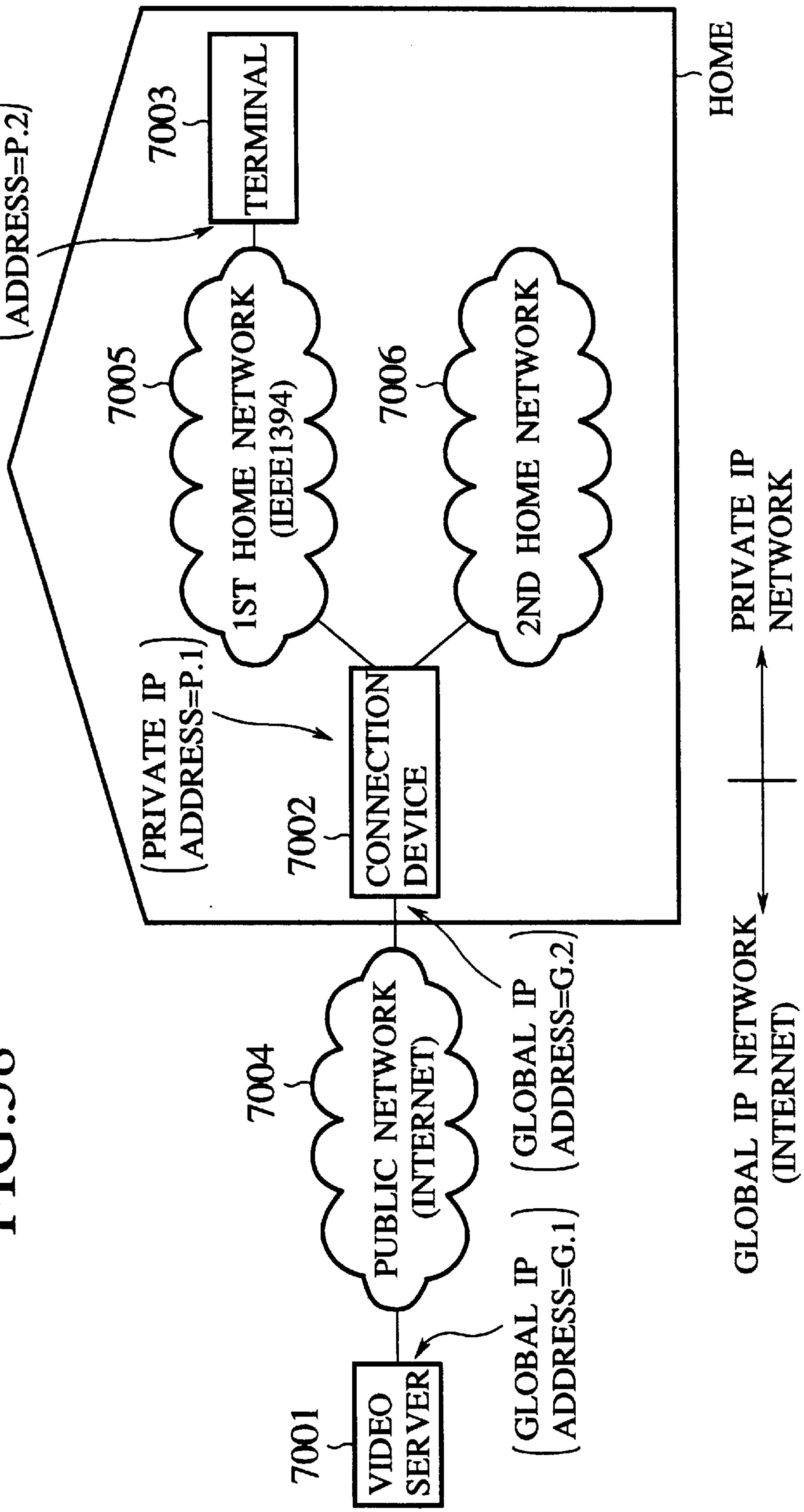
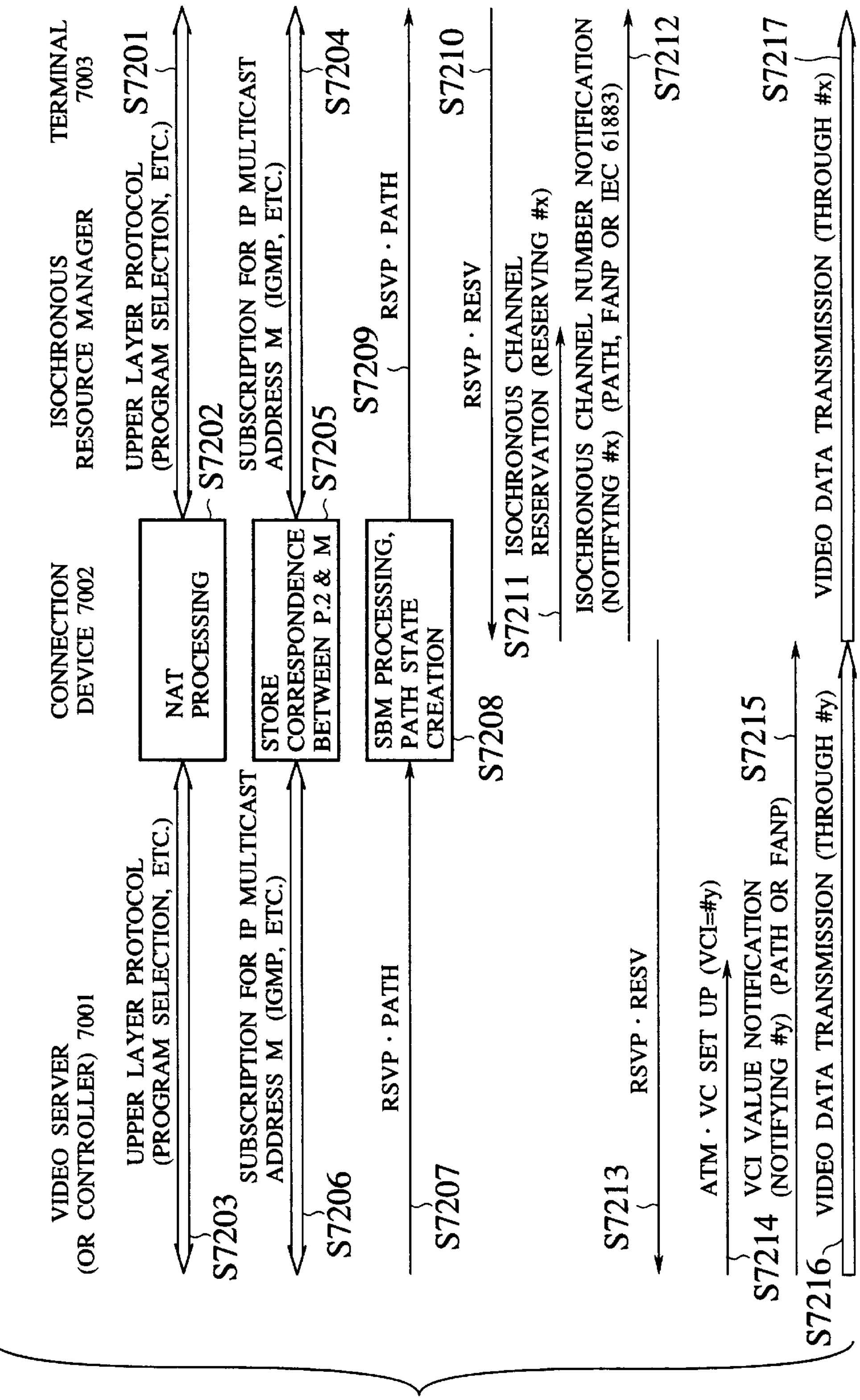

7001
VIDEO SERVER
(GLOBAL IP ADDRESS=G.1)
7004
PUBLIC NETWORK (INTERNET)
(GLOBAL IP ADDRESS=G.2)
7002
CONNECTION DEVICE
(PRIVATE IP ADDRESS=P.1)
7005
1ST HOME NETWORK (IEEE1394)
7006
2ND HOME NETWORK
7003
TERMINAL
(PRIVATE IP ADDRESS=P.2)
HOME
GLOBAL IP NETWORK (INTERNET)
PRIVATE IP NETWORK

FIG.59



VIDEO SERVER (OR CONTROLLER) 7001
CONNECTION DEVICE 7002
ISOCHRONOUS RESOURCE MANAGER
TERMINAL 7003
UPPER LAYER PROTOCOL (PROGRAM SELECTION, ETC.)
S7203
NAT PROCESSING
S7202
UPPER LAYER PROTOCOL (PROGRAM SELECTION, ETC.)
S7201
SUBSCRIPTION FOR IP MULTICAST ADDRESS M (IGMP, ETC.)
S7206
STORE CORRESPONDENCE BETWEEN P.2 & M
S7205
SUBSCRIPTION FOR IP MULTICAST ADDRESS M (IGMP, ETC.)
S7204
RSVP · PATH
S7207
SBM PROCESSING, PATH STATE CREATION
S7208
S7209
RSVP · PATH
RSVP · RESV
S7210
S7211
ISOCHRONOUS CHANNEL RESERVATION (RESERVING #x)
ISOCHRONOUS CHANNEL NUMBER NOTIFICATION (NOTIFYING #x) (PATH, FANP OR IEC 61883)
S7212
RSVP · RESV
S7213
ATM · VC SET UP (VCI=#y)
S7214
VCI VALUE NOTIFICATION (NOTIFYING #y) (PATH OR FANP)
S7215
VIDEO DATA TRANSMISSION (THROUGH #y)
S7216
VIDEO DATA TRANSMISSION (THROUGH #x)
S7217

FIG.60

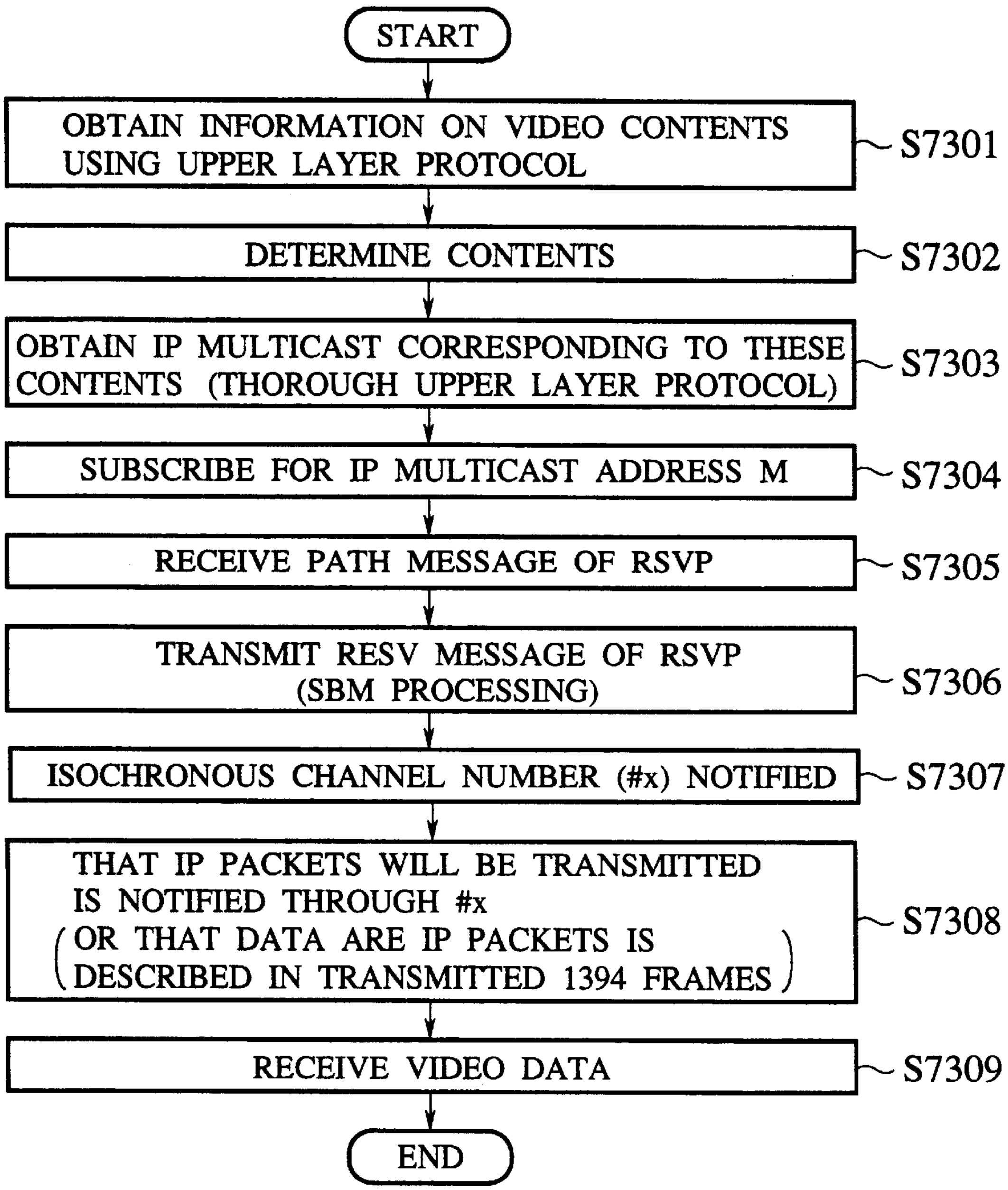

START
OBTAIN INFORMATION ON VIDEO CONTENTS USING UPPER LAYER PROTOCOL
S7301
DETERMINE CONTENTS
S7302
OBTAIN IP MULTICAST CORRESPONDING TO THESE CONTENTS (THOROUGH UPPER LAYER PROTOCOL)
S7303
SUBSCRIBE FOR IP MULTICAST ADDRESS M
S7304
RECEIVE PATH MESSAGE OF RSVP
S7305
TRANSMIT RESV MESSAGE OF RSVP (SBM PROCESSING)
S7306
ISOCHRONOUS CHANNEL NUMBER (#x) NOTIFIED
S7307
THAT IP PACKETS WILL BE TRANSMITTED IS NOTIFIED THROUGH #x (OR THAT DATA ARE IP PACKETS IS DESCRIBED IN TRANSMITTED 1394 FRAMES)
S7308
RECEIVE VIDEO DATA
S7309
END

FIG.61

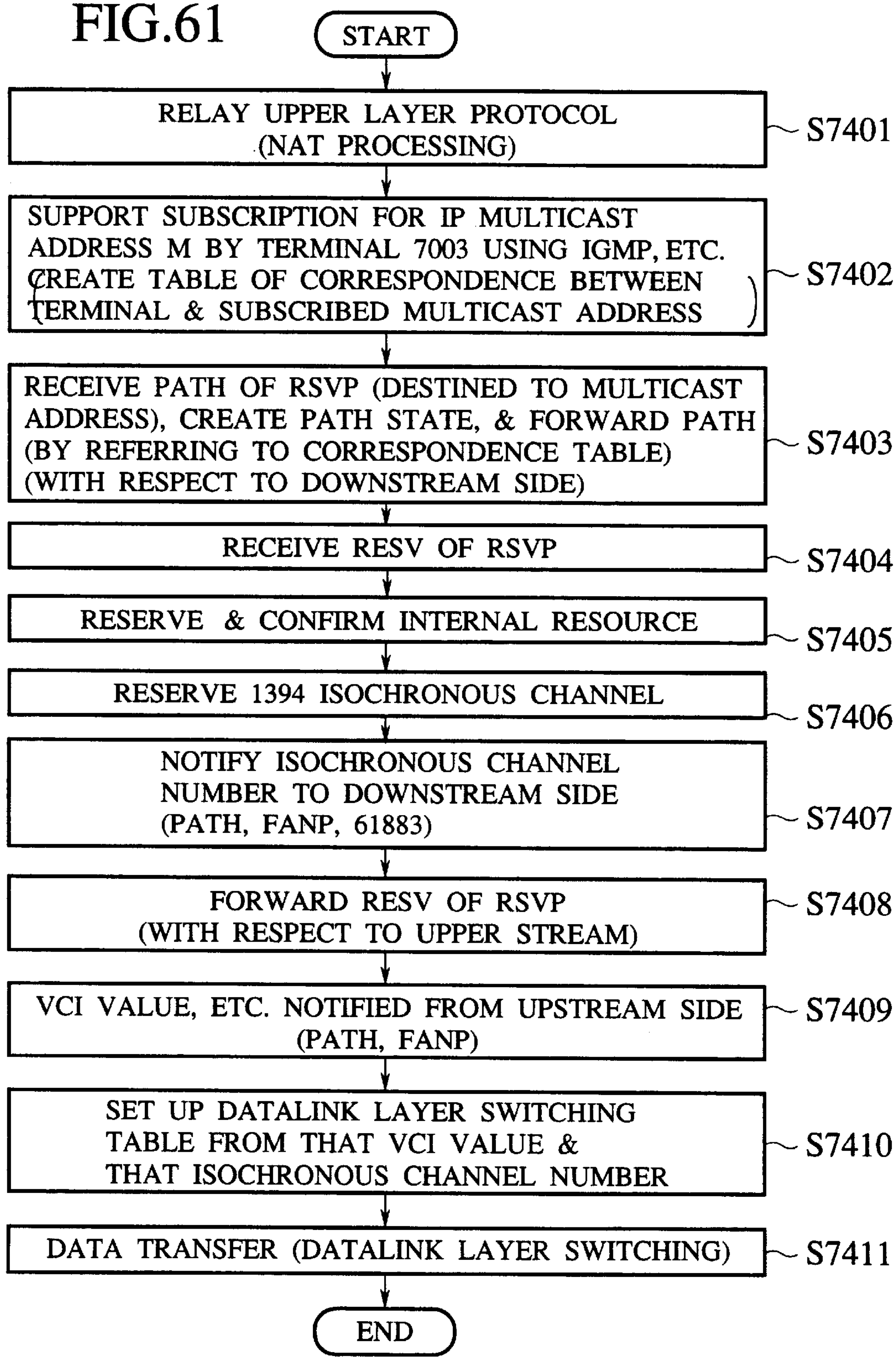

START
RELAY UPPER LAYER PROTOCOL (NAT PROCESSING)
S7401
SUPPORT SUBSCRIPTION FOR IP MULTICAST ADDRESS M BY TERMINAL 7003 USING IGMP, ETC. CREATE TABLE OF CORRESPONDENCE BETWEEN TERMINAL & SUBSCRIBED MULTICAST ADDRESS
S7402
RECEIVE PATH OF RSVP (DESTINED TO MULTICAST ADDRESS), CREATE PATH STATE, & FORWARD PATH (BY REFERRING TO CORRESPONDENCE TABLE) (WITH RESPECT TO DOWNSTREAM SIDE)
S7403
RECEIVE RESV OF RSVP
S7404
RESERVE & CONFIRM INTERNAL RESOURCE
S7405
RESERVE 1394 ISOCHRONOUS CHANNEL
S7406
NOTIFY ISOCHRONOUS CHANNEL NUMBER TO DOWNSTREAM SIDE (PATH, FANP, 61883)
S7407
FORWARD RESV OF RSVP (WITH RESPECT TO UPPER STREAM)
S7408
VCI VALUE, ETC. NOTIFIED FROM UPSTREAM SIDE (PATH, FANP)
S7409
SET UP DATALINK LAYER SWITCHING TABLE FROM THAT VCI VALUE & THAT ISOCHRONOUS CHANNEL NUMBER
S7410
DATA TRANSFER (DATALINK LAYER SWITCHING)
S7411
END

FIG.62

SUBSCRIBED MULTICAST ADDRESS	I/F OF TERMINAL	PRIVATE ADDRESS OF TERMINAL
M	1 (1ST HOME NETWORK)	P.2
	2	P.5
	---	---
---	---	---

FIG.63

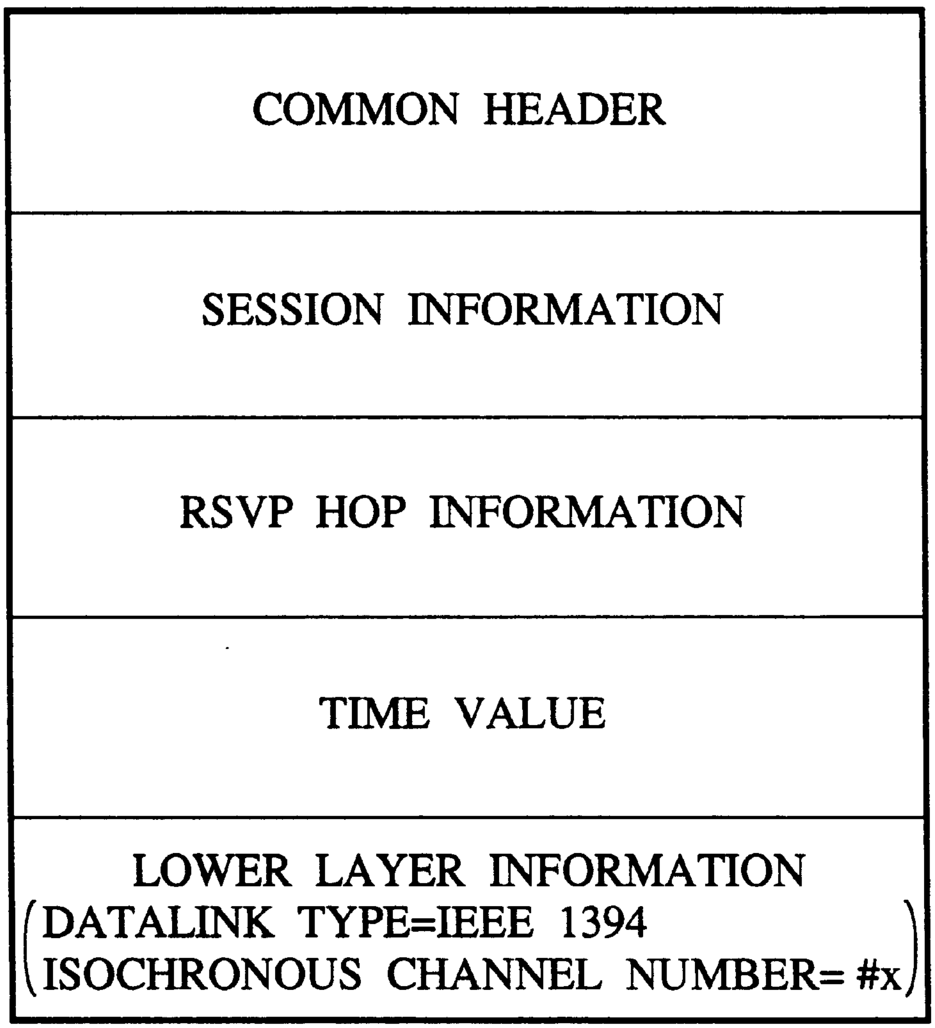
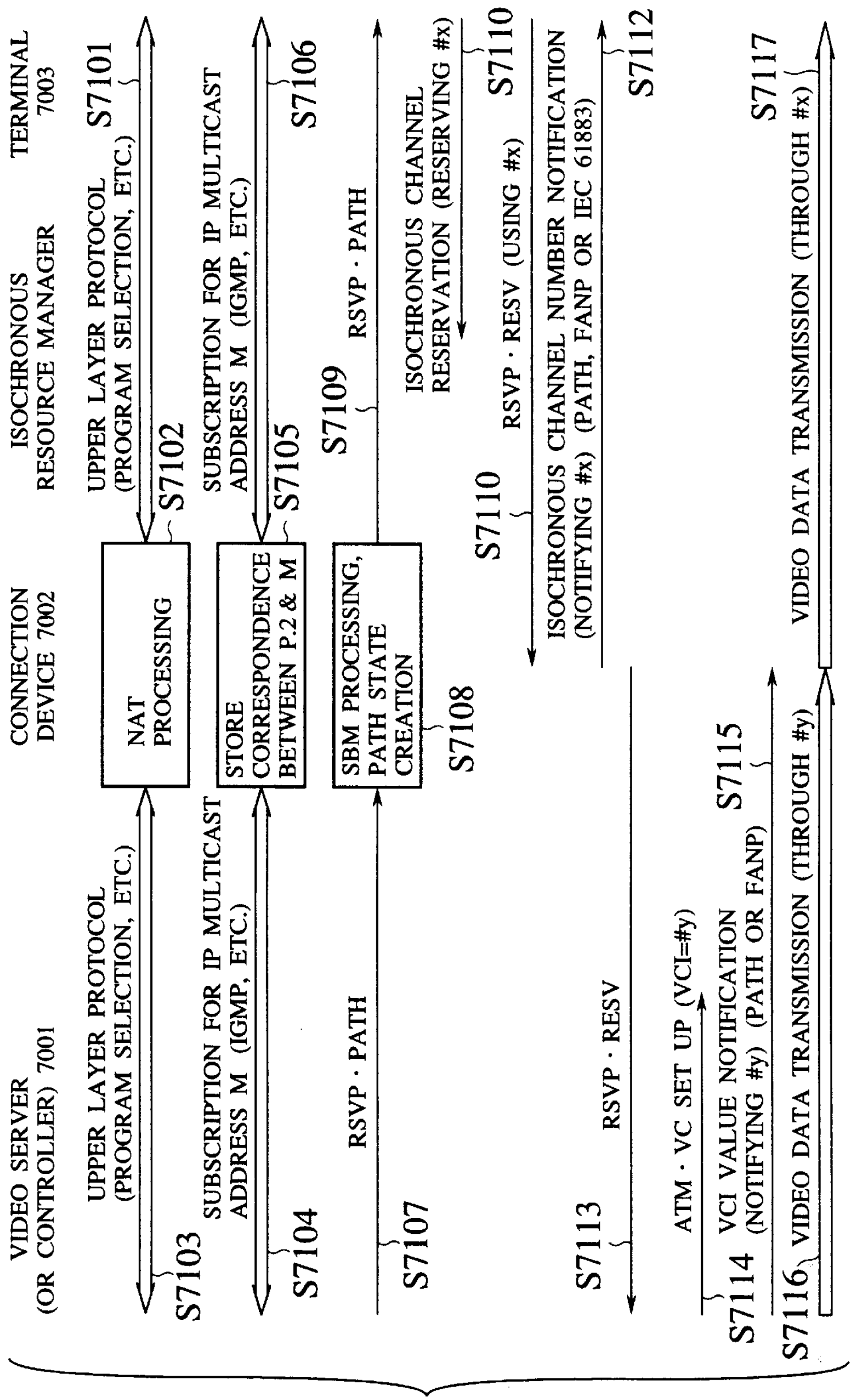

COMMON HEADER
SESSION INFORMATION
RSVP HOP INFORMATION
TIME VALUE
LOWER LAYER INFORMATION
(DATALINK TYPE=IEEE 1394
ISOCHRONOUS CHANNEL NUMBER= #x)

FIG.64

BASIC	NUMBER OF CONNECTIONS, ETC.	CHANNEL NUMBER	BANDWIDTH	ID, ETC.
EXTENDED	CHANNEL NUMBER	UPPER LAYER INFORMATION (MPEG/IP/···, IP FLOW)		OTHERS

FIG.65



VIDEO SERVER (OR CONTROLLER) 7001
CONNECTION DEVICE 7002
ISOCHRONOUS RESOURCE MANAGER
TERMINAL 7003
UPPER LAYER PROTOCOL (PROGRAM SELECTION, ETC.)
S7103
NAT PROCESSING
S7102
UPPER LAYER PROTOCOL (PROGRAM SELECTION, ETC.)
S7101
SUBSCRIPTION FOR IP MULTICAST ADDRESS M (IGMP, ETC.)
S7104
STORE CORRESPONDENCE BETWEEN P.2 & M
S7105
SUBSCRIPTION FOR IP MULTICAST ADDRESS M (IGMP, ETC.)
S7106
RSVP · PATH
S7107
SBM PROCESSING, PATH STATE CREATION
S7108
S7109
RSVP · PATH
ISOCHRONOUS CHANNEL RESERVATION (RESERVING #x)
S7110
RSVP · RESV (USING #x)
S7110
ISOCHRONOUS CHANNEL NUMBER NOTIFICATION (NOTIFYING #x) (PATH, FANP OR IEC 61883)
S7112
RSVP · RESV
S7113
ATM · VC SET UP (VCI=#y)
S7114
VCI VALUE NOTIFICATION (NOTIFYING #y) (PATH OR FANP)
S7115
VIDEO DATA TRANSMISSION (THROUGH #y)
S7116
VIDEO DATA TRANSMISSION (THROUGH #x)
S7117

FIG.66

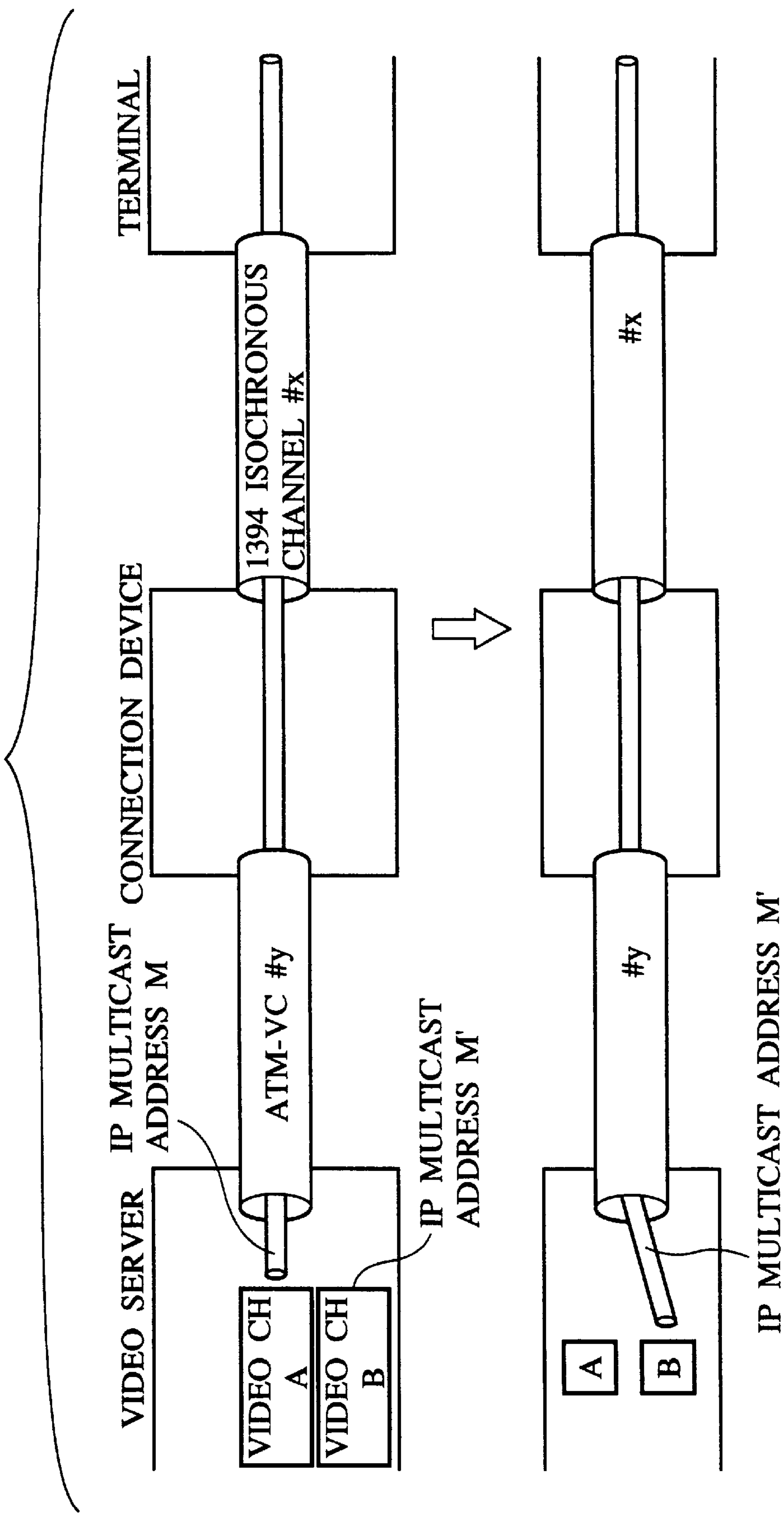

VIDEO SERVER
IP MULTICAST ADDRESS M
CONNECTION DEVICE
TERMINAL
VIDEO CH A
VIDEO CH B
IP MULTICAST ADDRESS M'
ATM-VC #y
1394 ISOCHRONOUS CHANNEL #x
A
B
#y
#x
IP MULTICAST ADDRESS M'

FIG.67

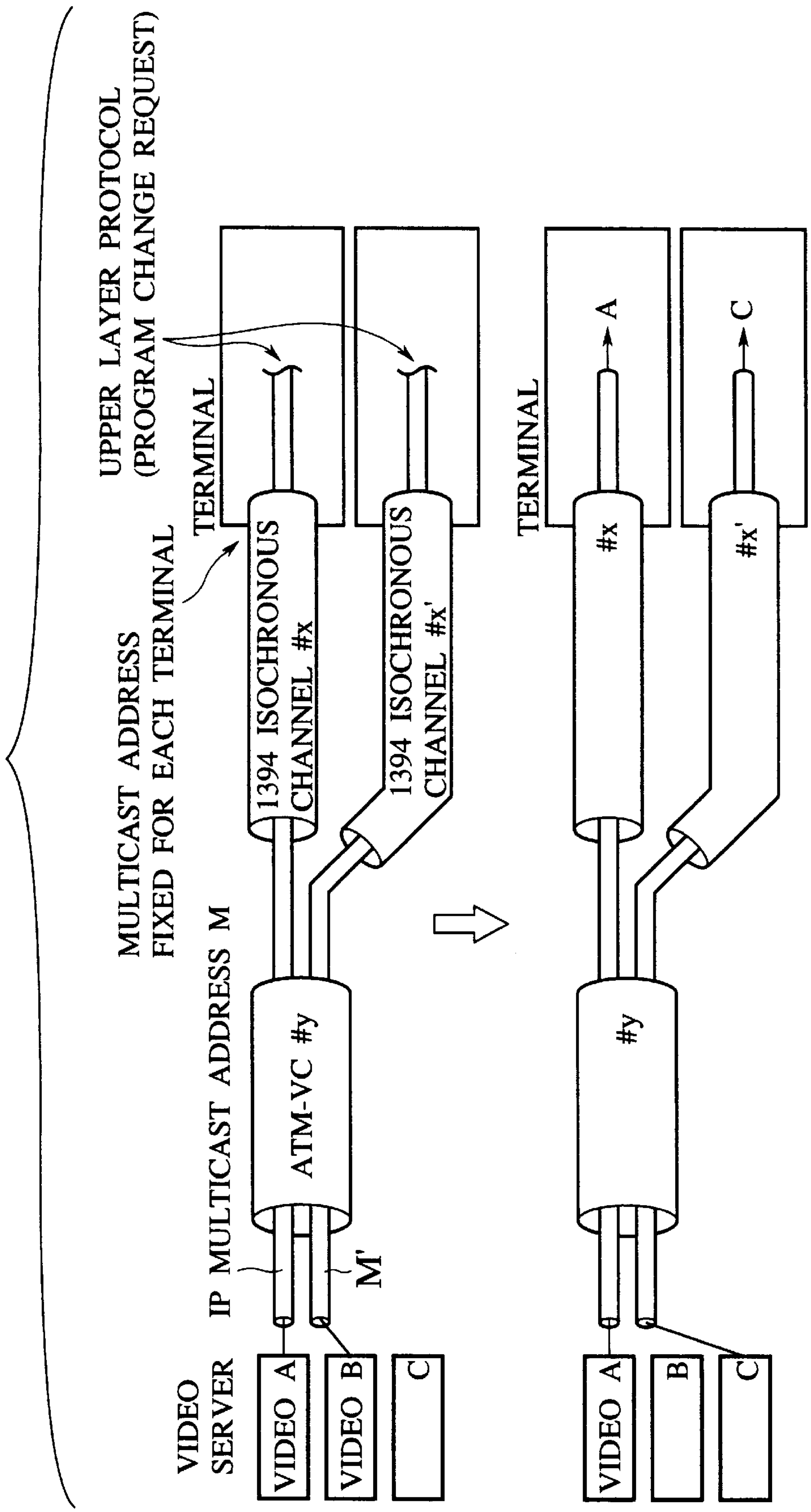
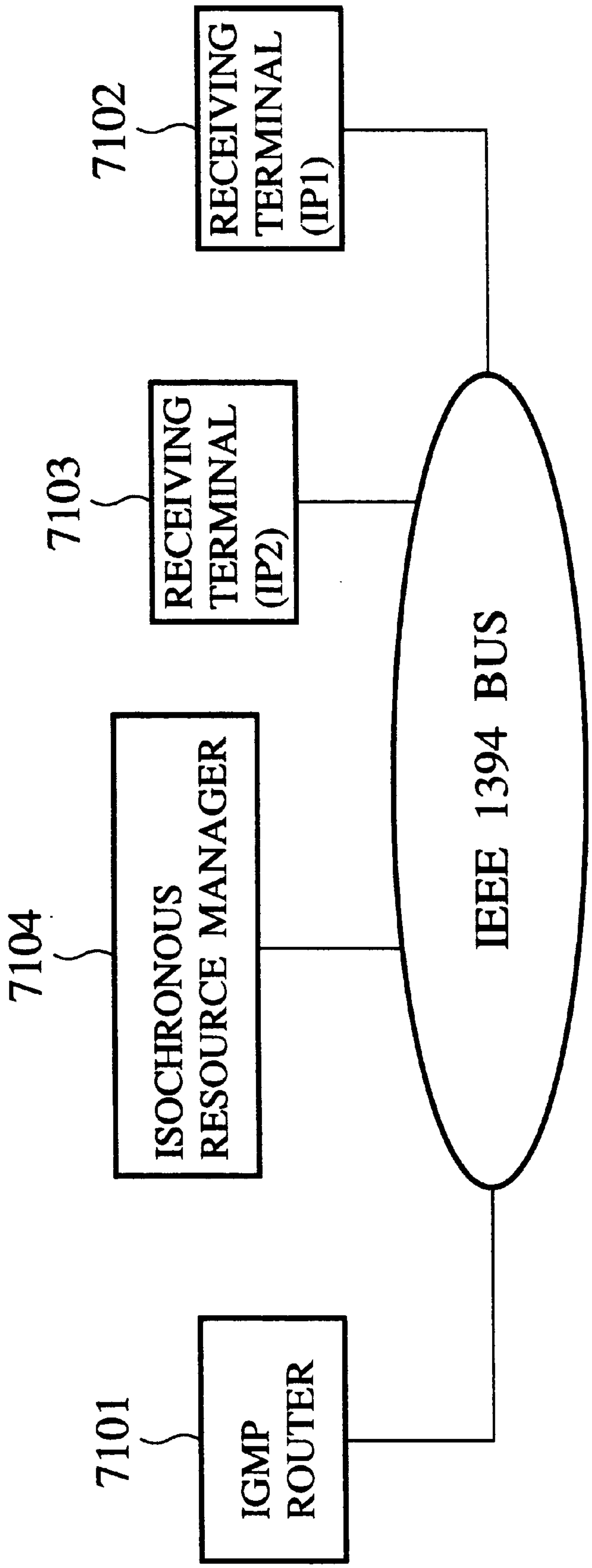

UPPER LAYER PROTOCOL
(PROGRAM CHANGE REQUEST)
TERMINAL
MULTICAST ADDRESS
FIXED FOR EACH TERMINAL
1394 ISOCHRONOUS
CHANNEL #x
1394 ISOCHRONOUS
CHANNEL #x'
IP MULTICAST ADDRESS M
ATM-VC #y
M'
VIDEO
SERVER
VIDEO A
VIDEO B
C
TERMINAL
A
C
#x
#x'
#y
VIDEO A
B
C

FIG.68


7102
RECEIVING TERMINAL (IP1)
7103
RECEIVING TERMINAL (IP2)
7104
ISOCHRONOUS RESOURCE MANAGER
IEEE 1394 BUS
7101
IGMP ROUTER

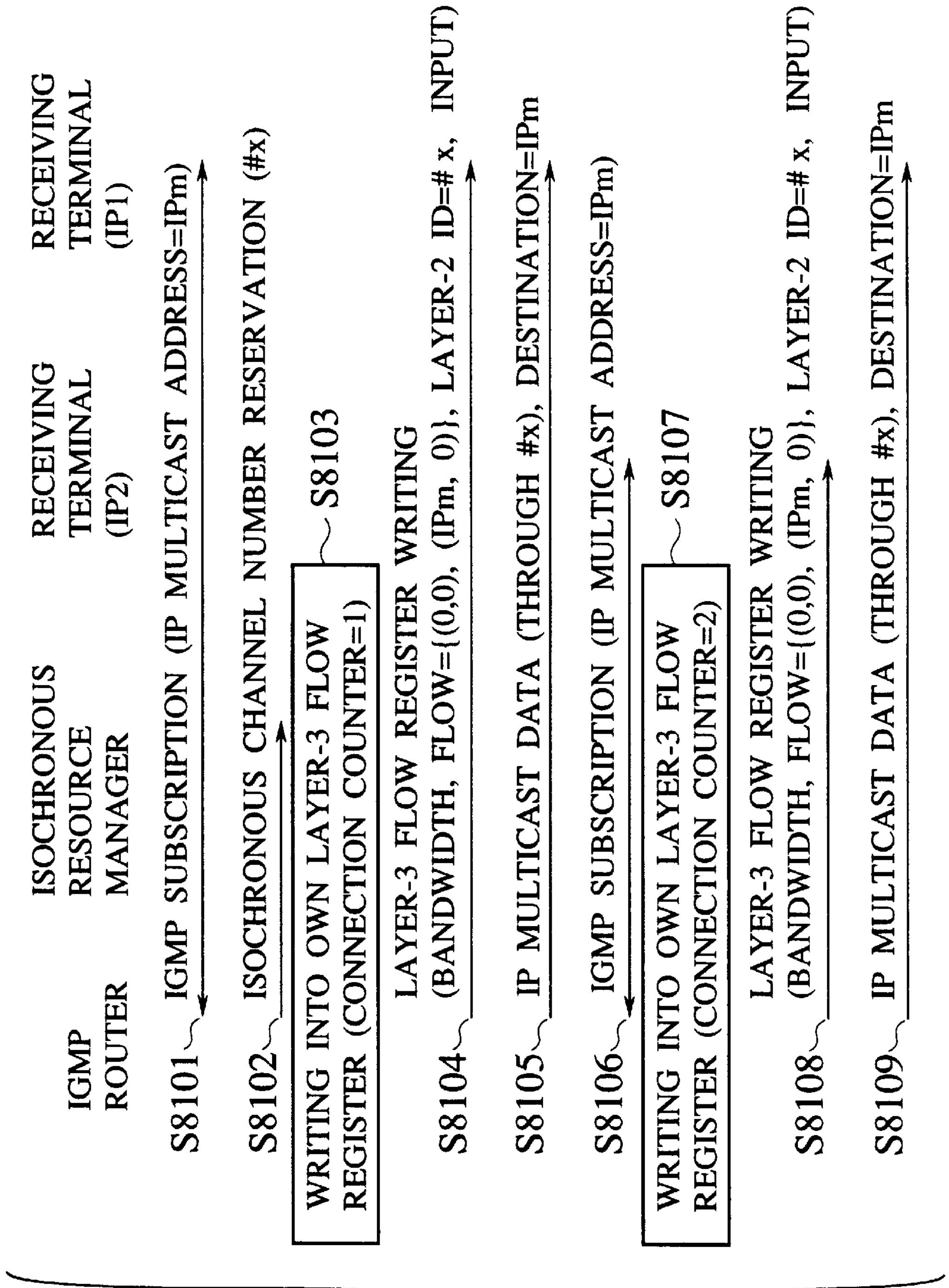

IGMP ROUTER
ISOCHRONOUS RESOURCE MANAGER
RECEIVING TERMINAL (IP2)
RECEIVING TERMINAL (IP1)
S8101
IGMP SUBSCRIPTION (IP MULTICAST ADDRESS=IPm)
S8102
ISOCHRONOUS CHANNEL NUMBER RESERVATION (#x)
WRITING INTO OWN LAYER-3 FLOW REGISTER (CONNECTION COUNTER=1)
S8103
S8104
LAYER-3 FLOW REGISTER WRITING (BANDWIDTH, FLOW={(0,0), (IPm, 0)}, LAYER-2 ID=# x, INPUT)
S8105
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm
S8106
IGMP SUBSCRIPTION (IP MULTICAST ADDRESS=IPm)
WRITING INTO OWN LAYER-3 FLOW REGISTER (CONNECTION COUNTER=2)
S8107
S8108
LAYER-3 FLOW REGISTER WRITING (BANDWIDTH, FLOW={(0,0), (IPm, 0)}, LAYER-2 ID=# x, INPUT)
S8109
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm

FIG.69

FIG.70

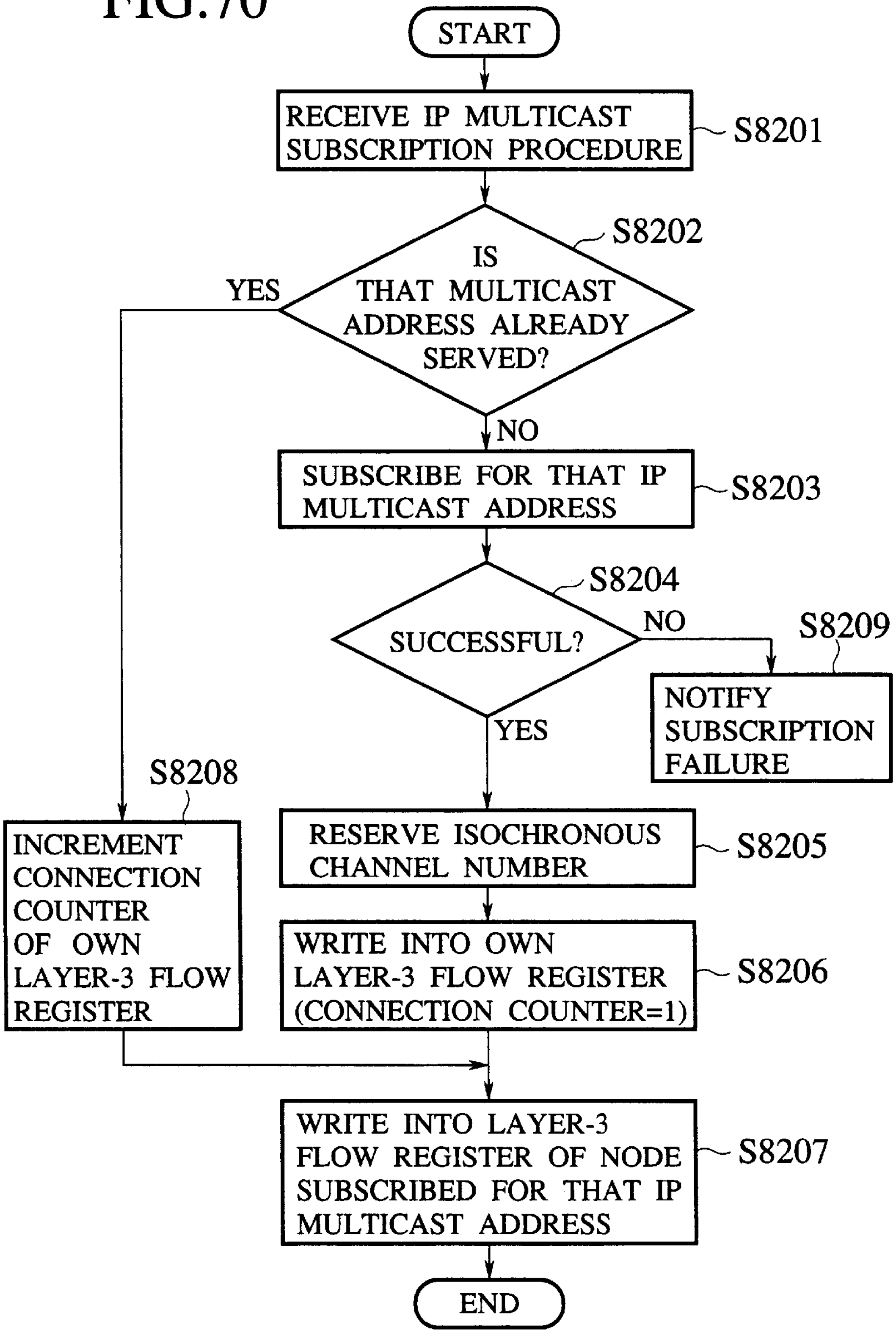
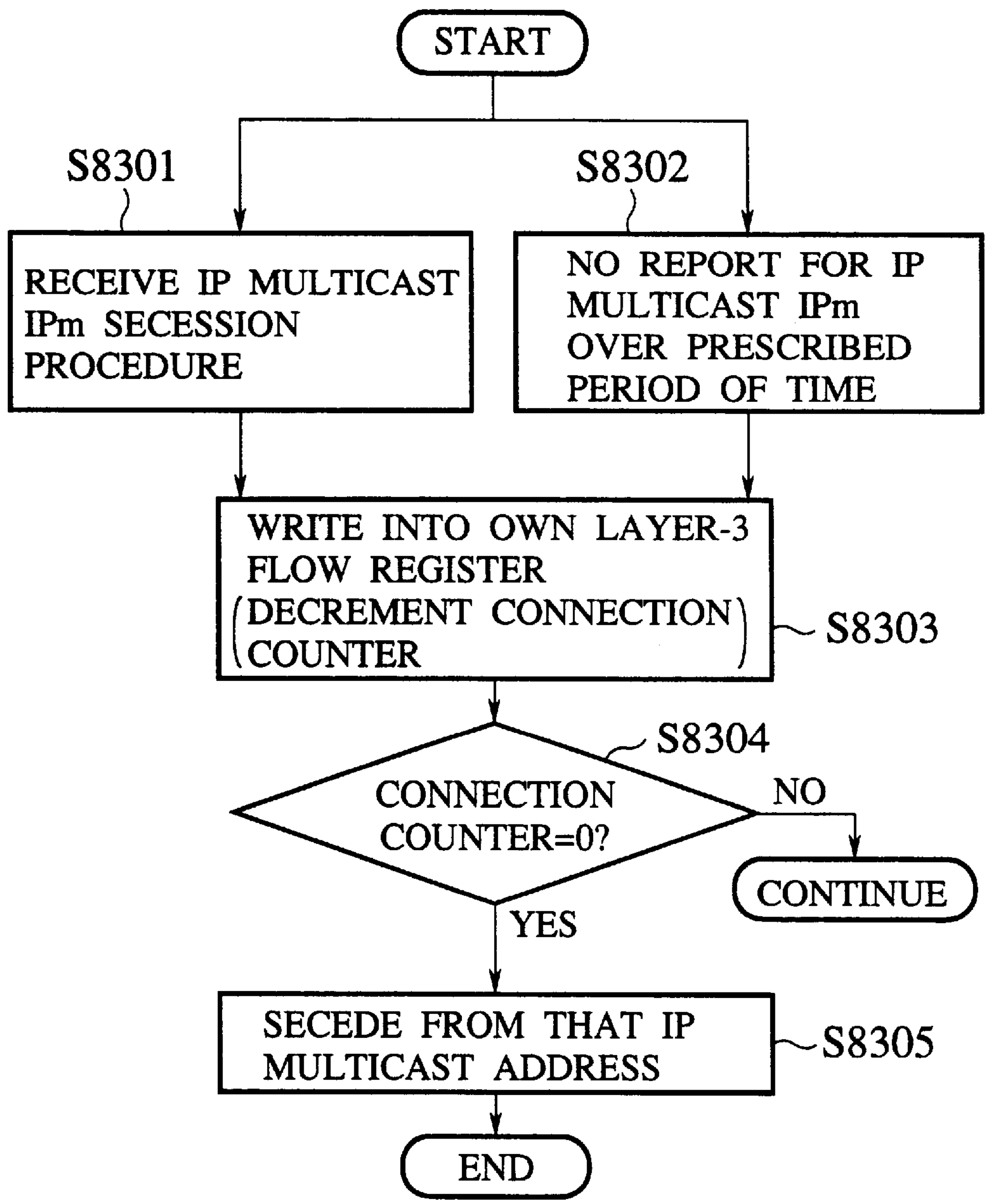

START
RECEIVE IP MULTICAST SUBSCRIPTION PROCEDURE
S8201
IS THAT MULTICAST ADDRESS ALREADY SERVED?
S8202
YES
NO
SUBSCRIBE FOR THAT IP MULTICAST ADDRESS
S8203
SUCCESSFUL?
S8204
NO
S8209
NOTIFY SUBSCRIPTION FAILURE
YES
S8208
INCREMENT CONNECTION COUNTER OF OWN LAYER-3 FLOW REGISTER
RESERVE ISOCHRONOUS CHANNEL NUMBER
S8205
WRITE INTO OWN LAYER-3 FLOW REGISTER (CONNECTION COUNTER=1)
S8206
WRITE INTO LAYER-3 FLOW REGISTER OF NODE SUBSCRIBED FOR THAT IP MULTICAST ADDRESS
S8207
END

FIG.71

LAYER-3 FLOW REGISTER

BANDWIDTH	
FLOW ID	SOURCE IP ADDRESS (0)
	SOURCE PORT NUMBER (0)
	DESTINATION IP ADDRESS (IPm)
	DESTINATION PORT NUMBER (0)
LAYER-2 ID	LAYER-2 TYPE (IEEE 1394)
	ID TYPE (ISOCHRONOUS CHANNEL NUMBER)
	ID (#x)
DIRECTION (OUTPUT)	
CONNECTION COUNTER	

FIG.72


START
S8301
RECEIVE IP MULTICAST IPm SECESSION PROCEDURE
S8302
NO REPORT FOR IP MULTICAST IPm OVER PRESCRIBED PERIOD OF TIME
WRITE INTO OWN LAYER-3 FLOW REGISTER (DECREMENT CONNECTION COUNTER)
S8303
CONNECTION COUNTER=0?
S8304
NO
CONTINUE
YES
SECEDE FROM THAT IP MULTICAST ADDRESS
S8305
END

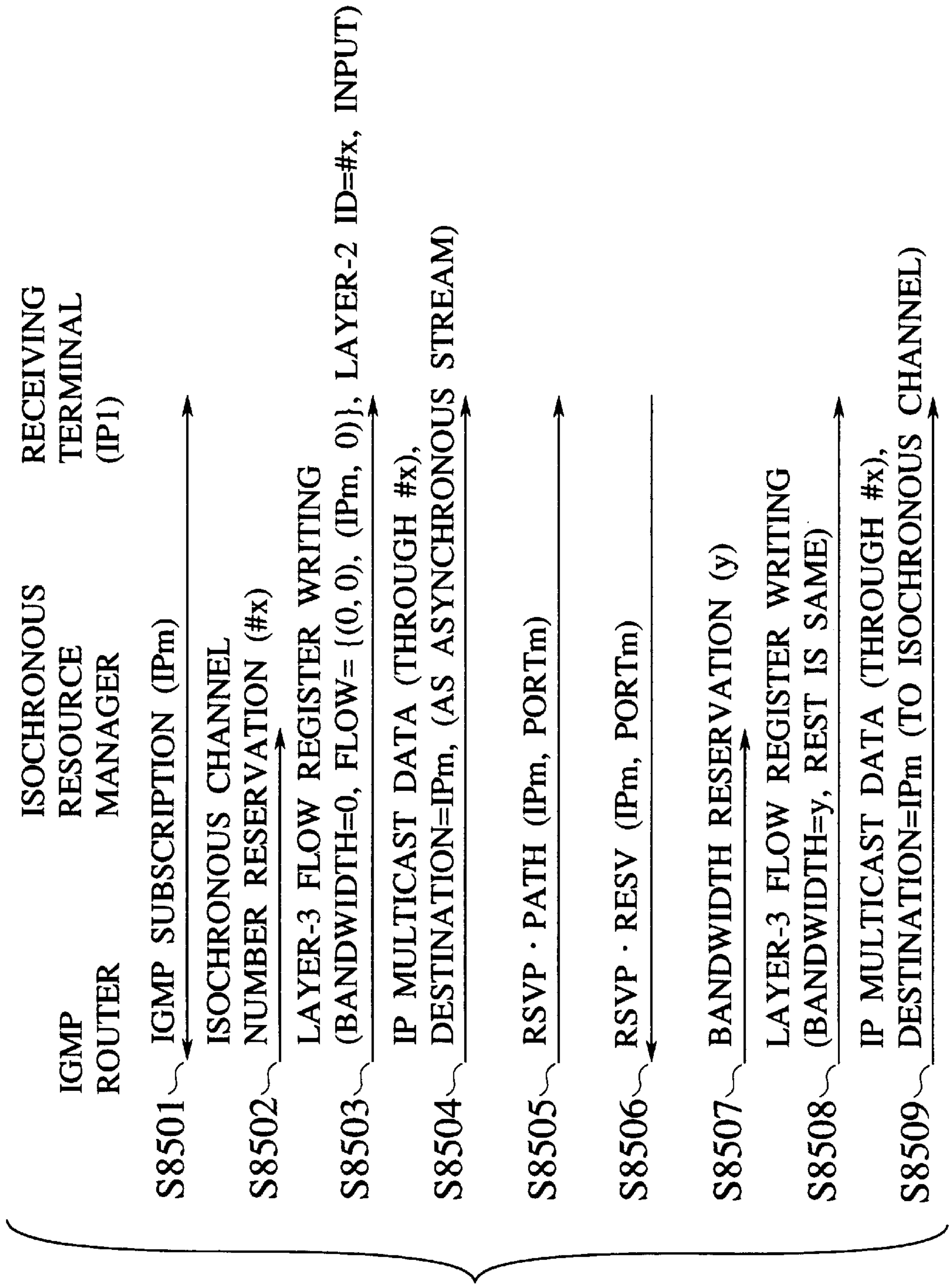

IGMP ROUTER
ISOCHRONOUS RESOURCE MANAGER
RECEIVING TERMINAL (IP1)
S8501
IGMP SUBSCRIPTION (IPm)
S8502
ISOCHRONOUS CHANNEL NUMBER RESERVATION (#x)
S8503
LAYER-3 FLOW REGISTER WRITING (BANDWIDTH=0, FLOW= {(0, 0), (IPm, 0)}, LAYER-2 ID=#x, INPUT)
S8504
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm, (AS ASYNCHRONOUS STREAM)
S8505
RSVP · PATH (IPm, PORTm)
S8506
RSVP · RESV (IPm, PORTm)
S8507
BANDWIDTH RESERVATION (y)
S8508
LAYER-3 FLOW REGISTER WRITING (BANDWIDTH=y, REST IS SAME)
S8509
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm (TO ISOCHRONOUS CHANNEL)

FIG.73

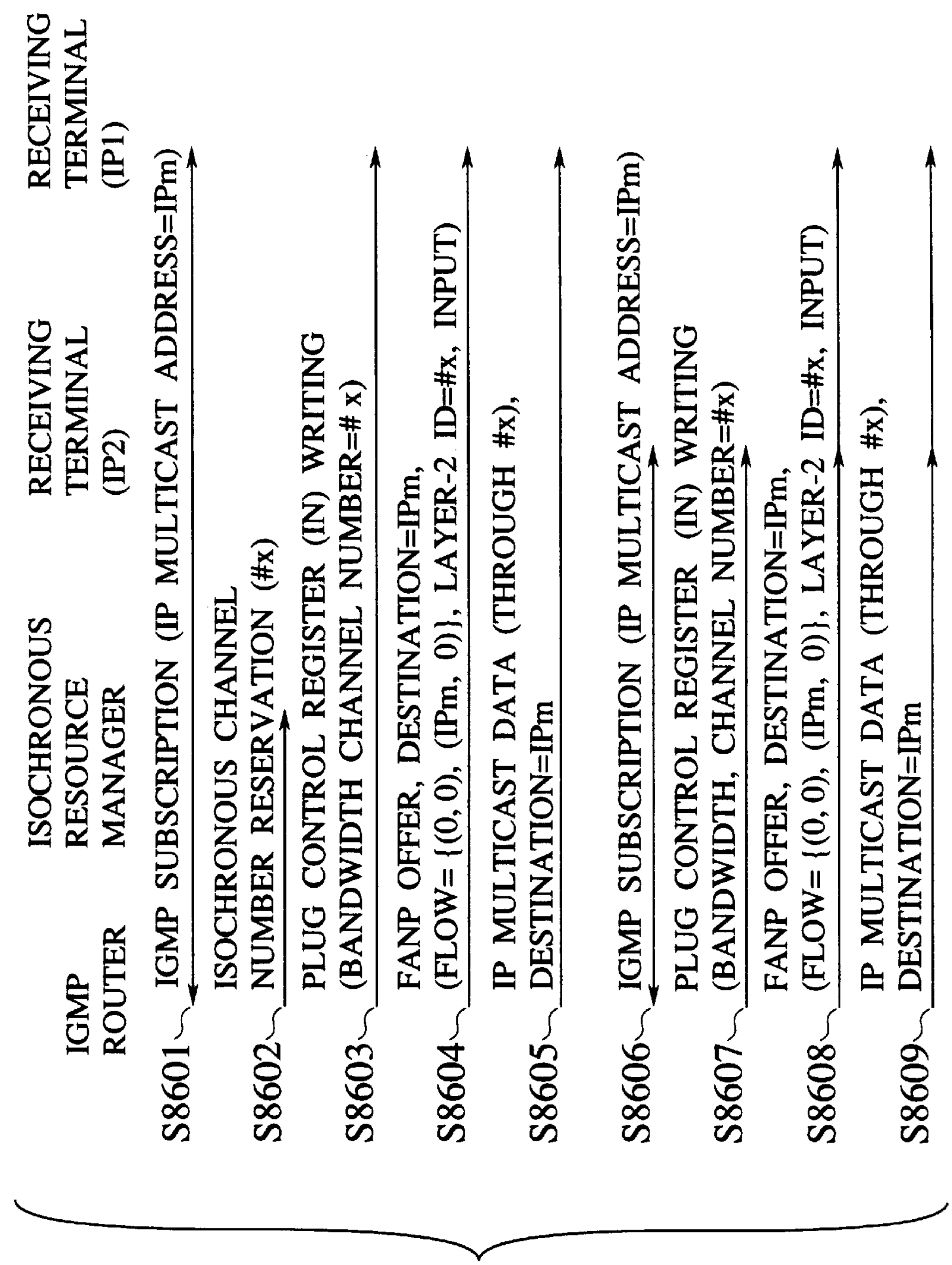

IGMP ROUTER
ISOCHRONOUS RESOURCE MANAGER
RECEIVING TERMINAL (IP2)
RECEIVING TERMINAL (IP1)
S8601
IGMP SUBSCRIPTION (IP MULTICAST ADDRESS=IPm)
S8602
ISOCHRONOUS CHANNEL NUMBER RESERVATION (#x)
S8603
PLUG CONTROL REGISTER (IN) WRITING (BANDWIDTH CHANNEL NUMBER=# x)
S8604
FANP OFFER, DESTINATION=IPm, (FLOW= {(0, 0), (IPm, 0)}, LAYER-2 ID=#x, INPUT)
S8605
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm
S8606
IGMP SUBSCRIPTION (IP MULTICAST ADDRESS=IPm)
S8607
PLUG CONTROL REGISTER (IN) WRITING (BANDWIDTH, CHANNEL NUMBER=#x)
S8608
FANP OFFER, DESTINATION=IPm, (FLOW= {(0, 0), (IPm, 0)}, LAYER-2 ID=#x, INPUT)
S8609
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm

FIG.74

FIG.75

FANP OFFER MESSAGE

VERSION NUMBER	
FLOW ID	SOURCE IP ADDRESS (0)
	SOURCE PORT NUMBER (0)
	DESTINATION IP ADDRESS (IPm)
	DESTINATION PORT NUMBER (0)
LAYER-2 ID	LAYER-2 TYPE (IEEE 1394)
	ID TYPE (ISOCHRONOUS CHANNEL NUMBER)
	ID (#x)
DIRECTION (INPUT)	

FIG.76

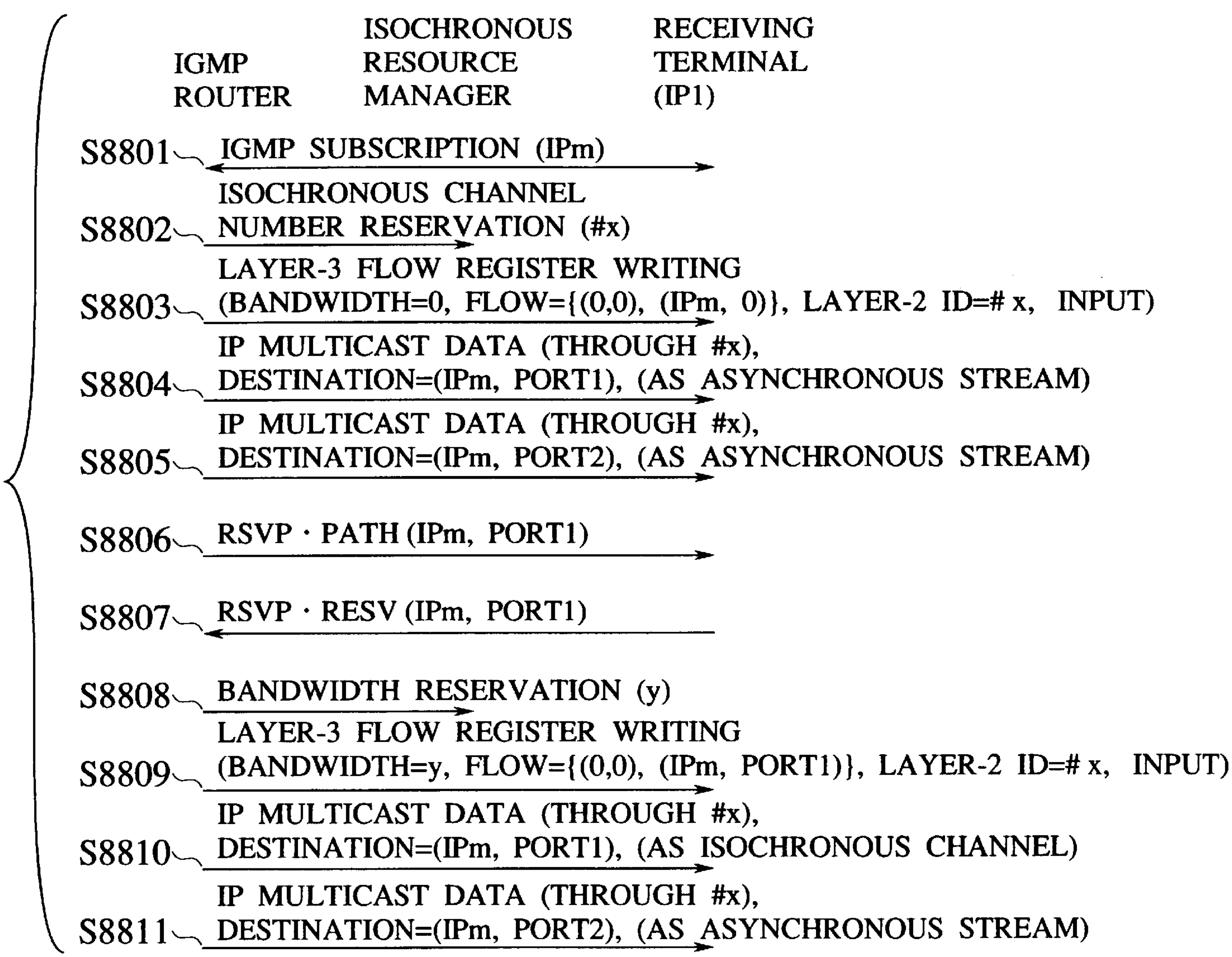

IGMP ROUTER
ISOCHRONOUS RESOURCE MANAGER
RECEIVING TERMINAL (IP1)
S8801
IGMP SUBSCRIPTION (IPm)
S8802
ISOCHRONOUS CHANNEL NUMBER RESERVATION (#x)
S8803
LAYER-3 FLOW REGISTER WRITING (BANDWIDTH=0, FLOW={(0,0), (IPm, 0)}, LAYER-2 ID=# x, INPUT)
S8804
IP MULTICAST DATA (THROUGH #x), DESTINATION=(IPm, PORT1), (AS ASYNCHRONOUS STREAM)
S8805
IP MULTICAST DATA (THROUGH #x), DESTINATION=(IPm, PORT2), (AS ASYNCHRONOUS STREAM)
S8806
RSVP · PATH (IPm, PORT1)
S8807
RSVP · RESV (IPm, PORT1)
S8808
BANDWIDTH RESERVATION (y)
S8809
LAYER-3 FLOW REGISTER WRITING (BANDWIDTH=y, FLOW={(0,0), (IPm, PORT1)}, LAYER-2 ID=# x, INPUT)
S8810
IP MULTICAST DATA (THROUGH #x), DESTINATION=(IPm, PORT1), (AS ISOCHRONOUS CHANNEL)
S8811
IP MULTICAST DATA (THROUGH #x), DESTINATION=(IPm, PORT2), (AS ASYNCHRONOUS STREAM)

FIG.77

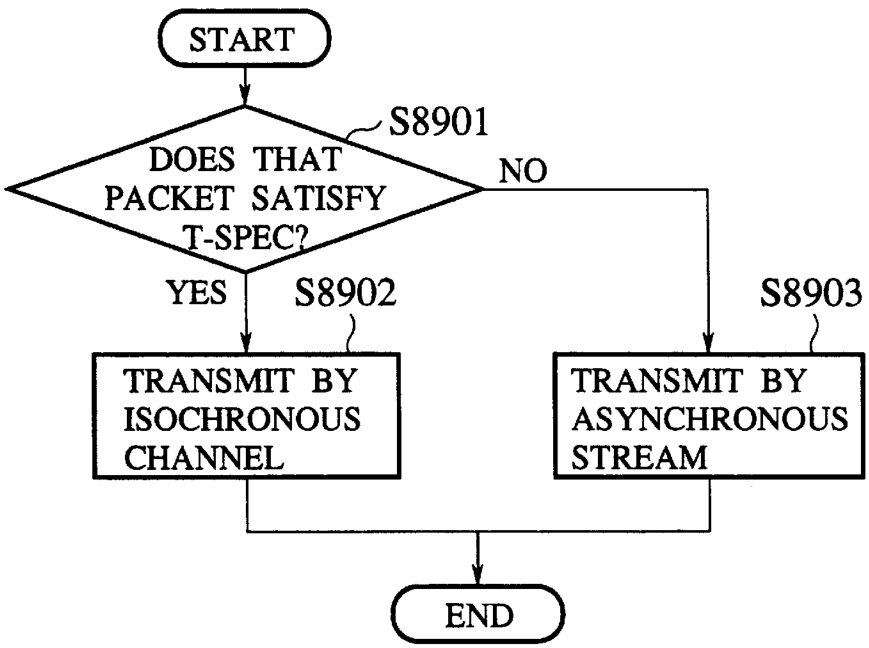
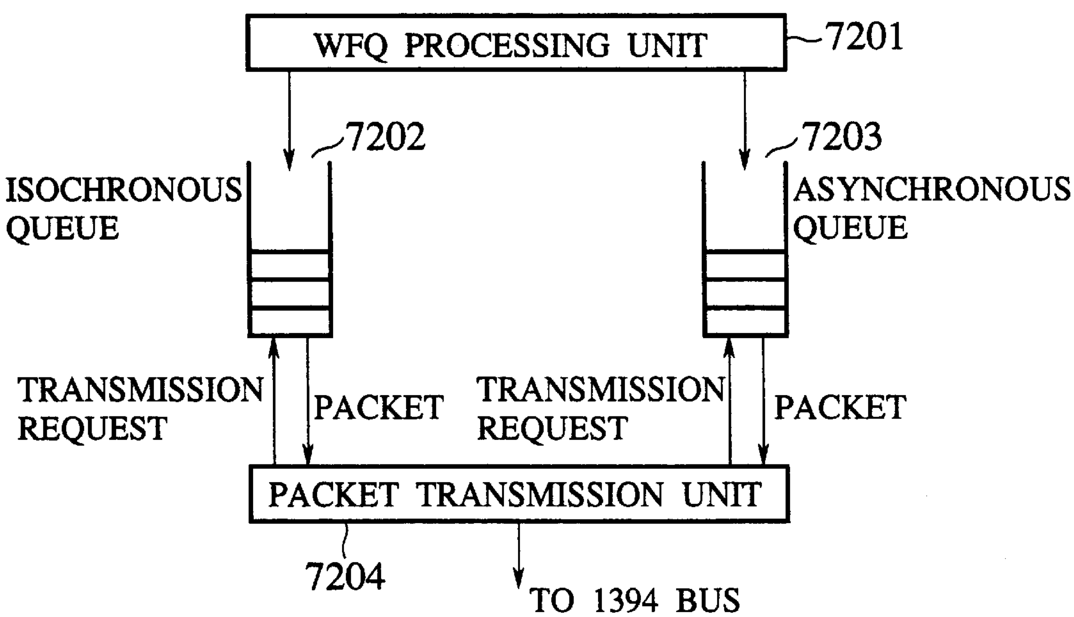

START
S8901
DOES THAT PACKET SATISFY T-SPEC?
NO
YES
S8902
S8903
TRANSMIT BY ISOCHRONOUS CHANNEL
TRANSMIT BY ASYNCHRONOUS STREAM
END

FIG.78


WFQ PROCESSING UNIT
7201
7202
7203
ISOCHRONOUS QUEUE
ASYNCHRONOUS QUEUE
TRANSMISSION REQUEST
PACKET
TRANSMISSION REQUEST
PACKET
PACKET TRANSMISSION UNIT
7204
TO 1394 BUS

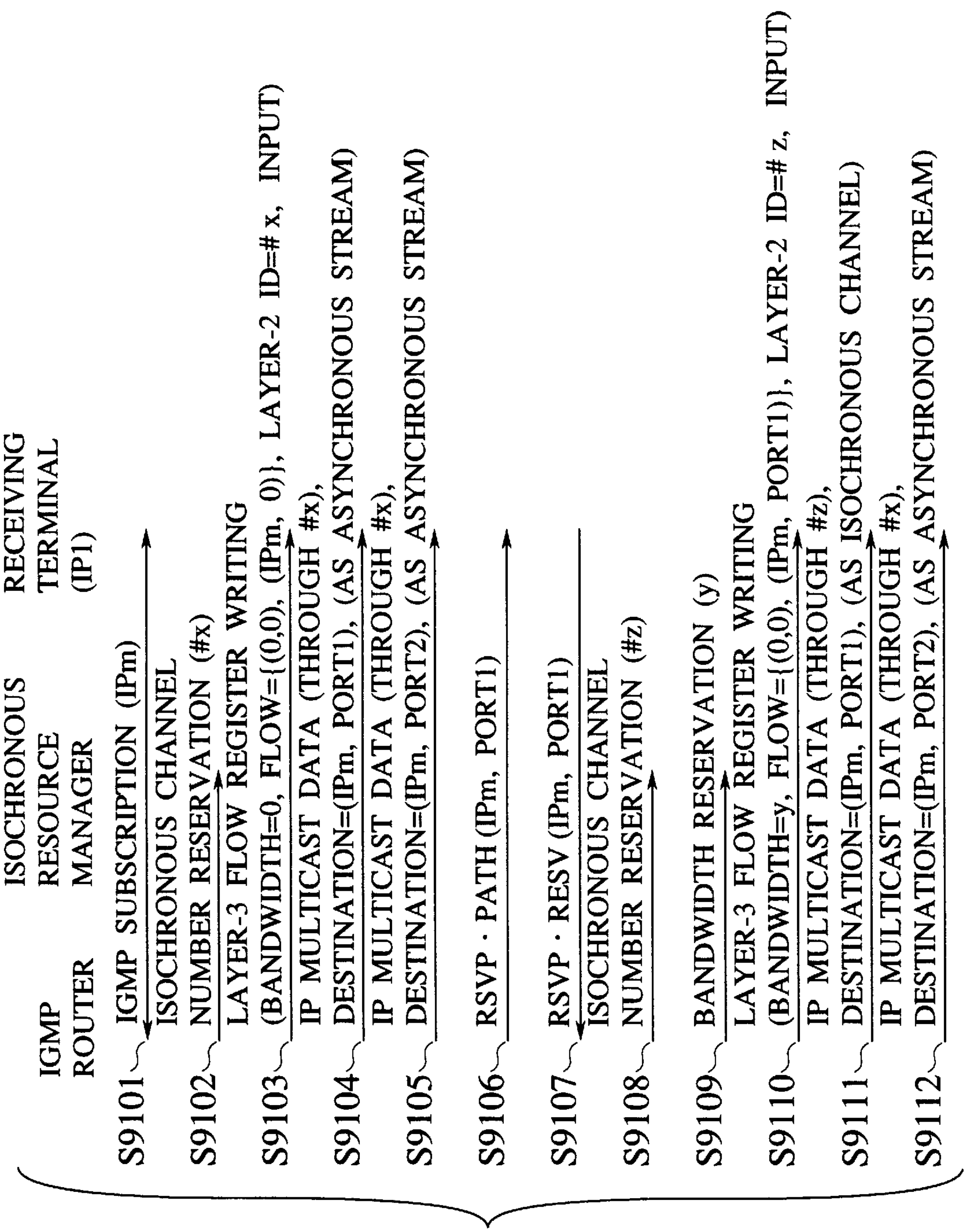

IGMP ROUTER
ISOCHRONOUS RESOURCE MANAGER
RECEIVING TERMINAL (IP1)
S9101
IGMP SUBSCRIPTION (IPm)
S9102
ISOCHRONOUS CHANNEL NUMBER RESERVATION (#x)
S9103
LAYER-3 FLOW REGISTER WRITING (BANDWIDTH=0, FLOW={(0,0), (IPm, 0)}, LAYER-2 ID=# x, INPUT)
S9104
IP MULTICAST DATA (THROUGH #x), DESTINATION=(IPm, PORT1), (AS ASYNCHRONOUS STREAM)
S9105
IP MULTICAST DATA (THROUGH #x), DESTINATION=(IPm, PORT2), (AS ASYNCHRONOUS STREAM)
S9106
RSVP · PATH (IPm, PORT1)
S9107
RSVP · RESV (IPm, PORT1)
S9108
ISOCHRONOUS CHANNEL NUMBER RESERVATION (#z)
S9109
BANDWIDTH RESERVATION (y)
S9110
LAYER-3 FLOW REGISTER WRITING (BANDWIDTH=y, FLOW={(0,0), (IPm, PORT1)}, LAYER-2 ID=# z, INPUT)
S9111
IP MULTICAST DATA (THROUGH #z), DESTINATION=(IPm, PORT1), (AS ISOCHRONOUS CHANNEL)
S9112
IP MULTICAST DATA (THROUGH #x), DESTINATION=(IPm, PORT2), (AS ASYNCHRONOUS STREAM)

FIG.79

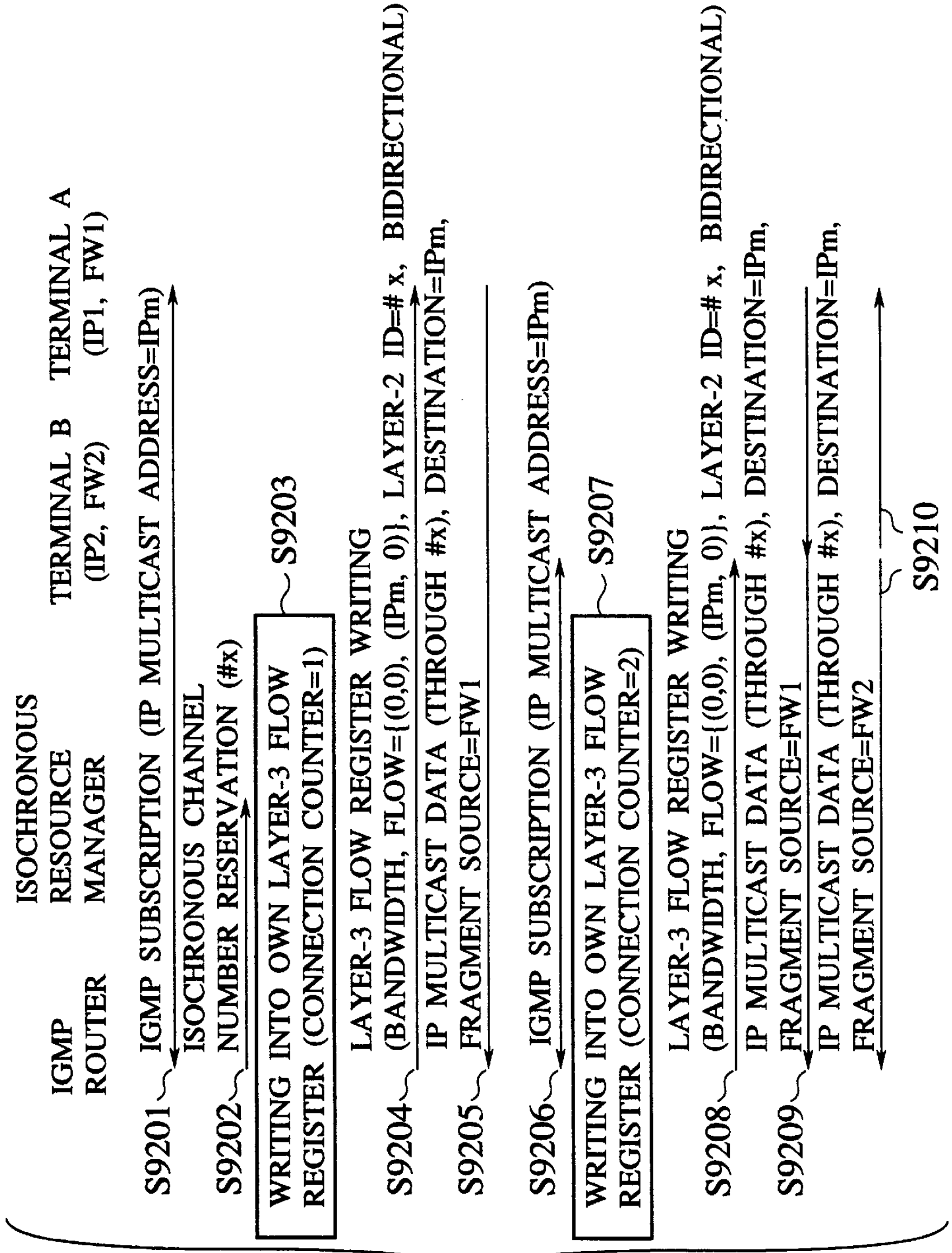

IGMP ROUTER
ISOCHRONOUS RESOURCE MANAGER
TERMINAL B (IP2, FW2)
TERMINAL A (IP1, FW1)
S9201
IGMP SUBSCRIPTION (IP MULTICAST ADDRESS=IPm)
S9202
ISOCHRONOUS CHANNEL NUMBER RESERVATION (#x)
S9203
WRITING INTO OWN LAYER-3 FLOW REGISTER (CONNECTION COUNTER=1)
S9204
LAYER-3 FLOW REGISTER WRITING (BANDWIDTH, FLOW={(0,0), (IPm, 0)}, LAYER-2 ID=# x, BIDIRECTIONAL)
S9205
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm, FRAGMENT SOURCE=FW1
S9206
IGMP SUBSCRIPTION (IP MULTICAST ADDRESS=IPm)
S9207
WRITING INTO OWN LAYER-3 FLOW REGISTER (CONNECTION COUNTER=2)
S9208
LAYER-3 FLOW REGISTER WRITING (BANDWIDTH, FLOW={(0,0), (IPm, 0)}, LAYER-2 ID=# x, BIDIRECTIONAL)
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm, FRAGMENT SOURCE=FW1
S9209
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm, FRAGMENT SOURCE=FW2
S9210

FIG.80

FIG.81A

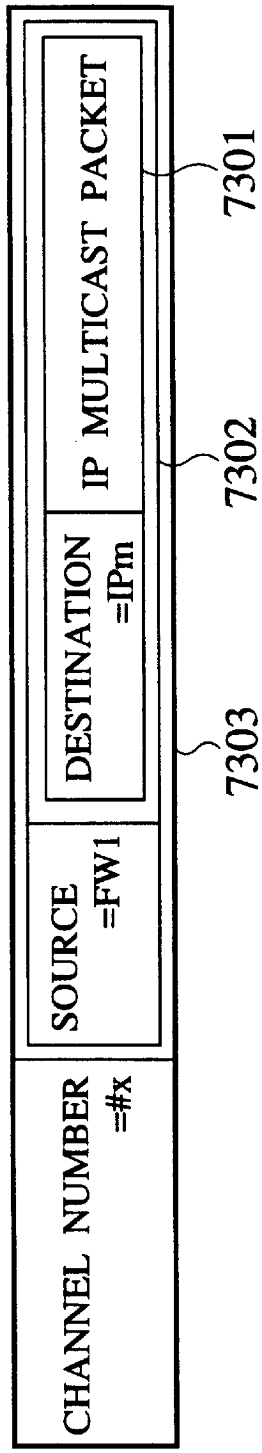
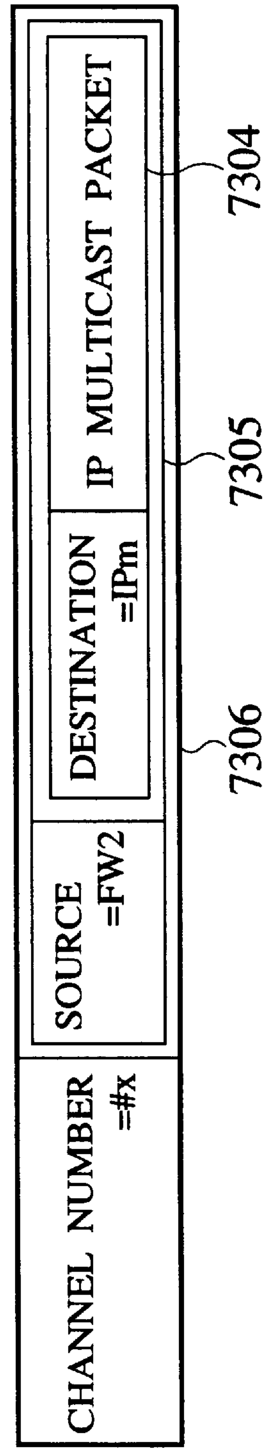


FIG.81B



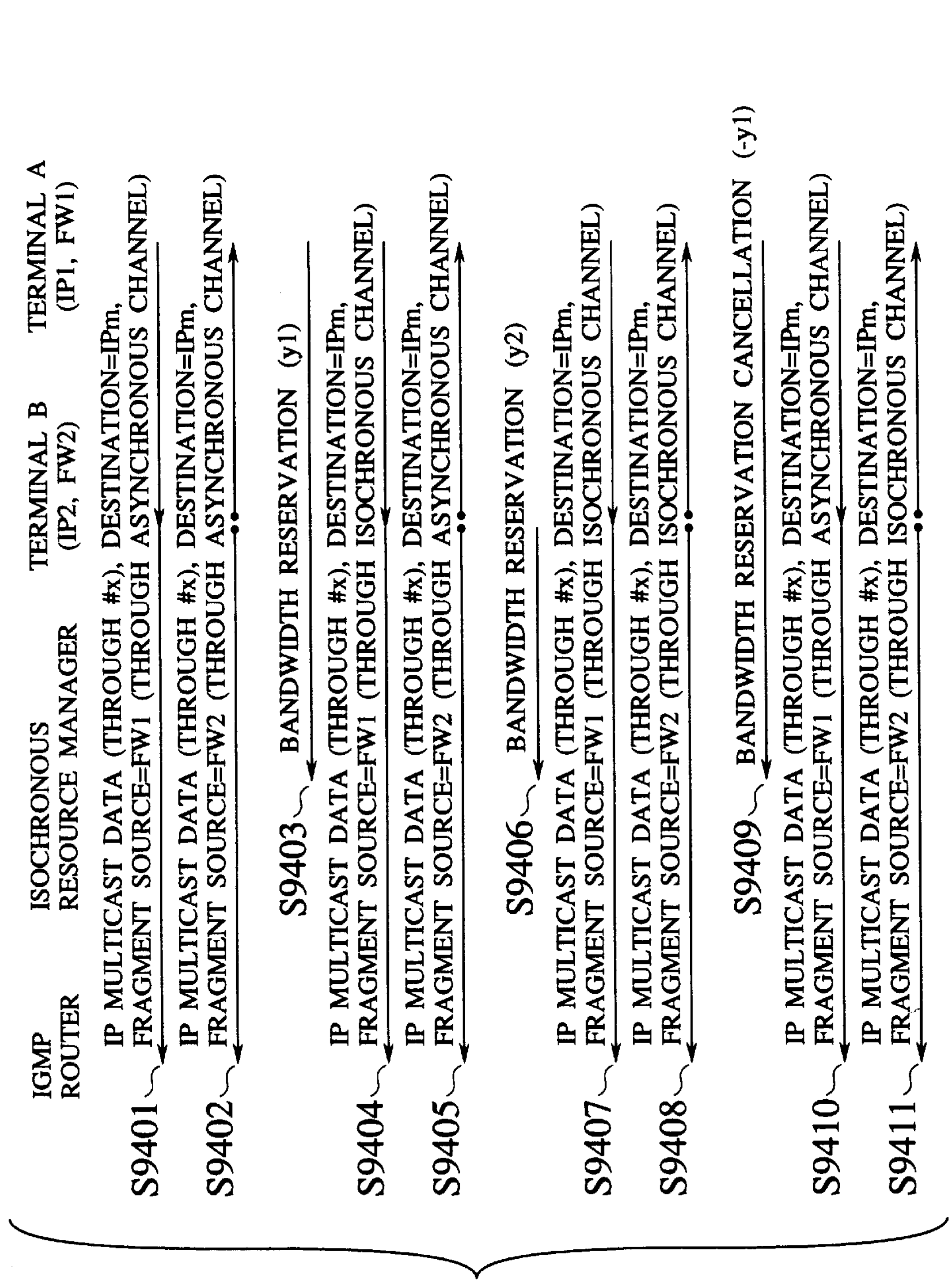

IGMP ROUTER
ISOCHRONOUS RESOURCE MANAGER
TERMINAL B (IP2, FW2)
TERMINAL A (IP1, FW1)
S9401
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm, FRAGMENT SOURCE=FW1 (THROUGH ASYNCHRONOUS CHANNEL)
S9402
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm, FRAGMENT SOURCE=FW2 (THROUGH ASYNCHRONOUS CHANNEL)
S9403
BANDWIDTH RESERVATION (y1)
S9404
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm, FRAGMENT SOURCE=FW1 (THROUGH ISOCHRONOUS CHANNEL)
S9405
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm, FRAGMENT SOURCE=FW2 (THROUGH ASYNCHRONOUS CHANNEL)
S9406
BANDWIDTH RESERVATION (y2)
S9407
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm, FRAGMENT SOURCE=FW1 (THROUGH ISOCHRONOUS CHANNEL)
S9408
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm, FRAGMENT SOURCE=FW2 (THROUGH ISOCHRONOUS CHANNEL)
S9409
BANDWIDTH RESERVATION CANCELLATION (-y1)
S9410
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm, FRAGMENT SOURCE=FW1 (THROUGH ASYNCHRONOUS CHANNEL)
S9411
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm, FRAGMENT SOURCE=FW2 (THROUGH ISOCHRONOUS CHANNEL)

FIG.82

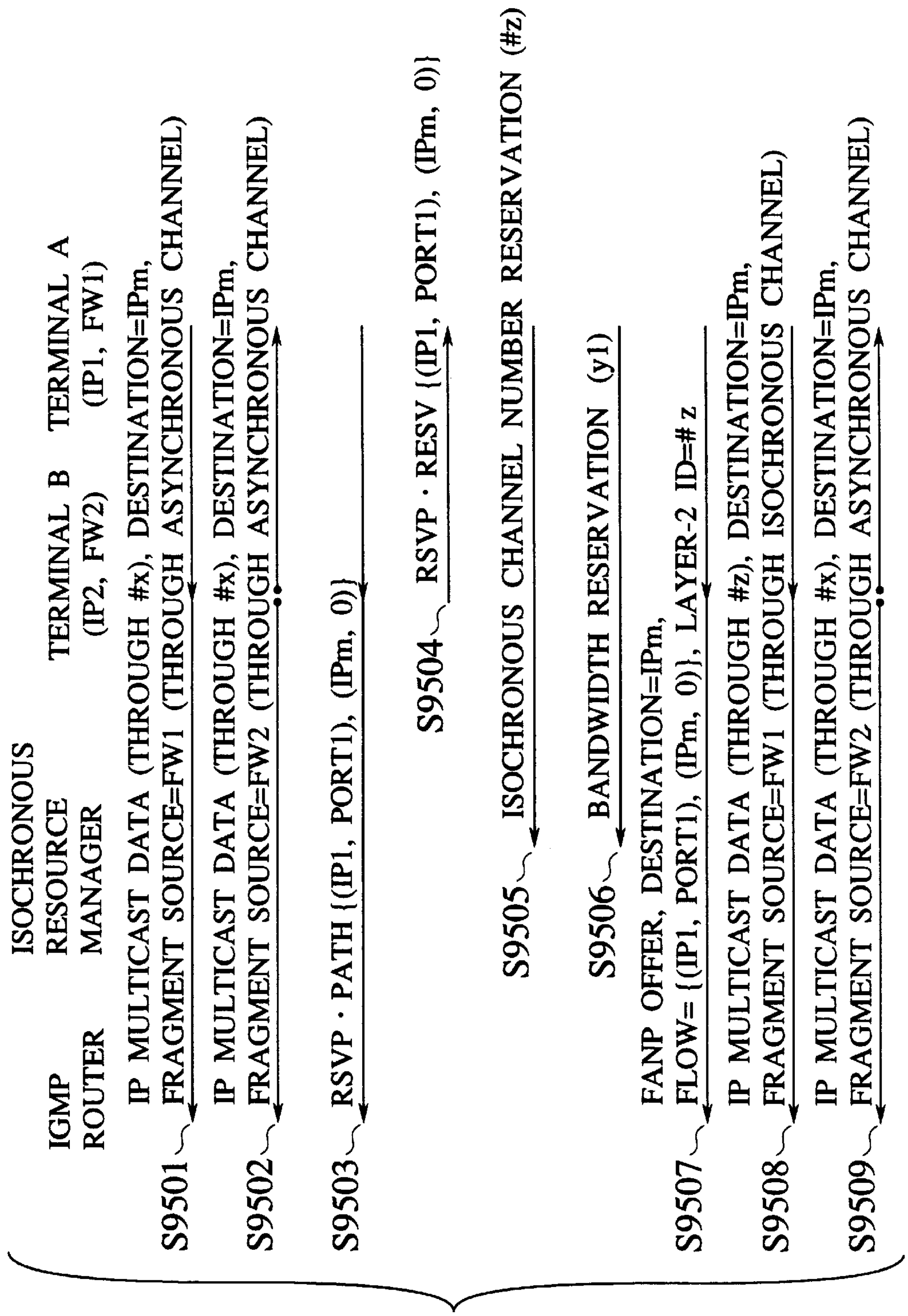

IGMP ROUTER
ISOCHRONOUS RESOURCE MANAGER
TERMINAL B (IP2, FW2)
TERMINAL A (IP1, FW1)
S9501
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm,
FRAGMENT SOURCE=FW1 (THROUGH ASYNCHRONOUS CHANNEL)
S9502
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm,
FRAGMENT SOURCE=FW2 (THROUGH ASYNCHRONOUS CHANNEL)
S9503
RSVP · PATH {(IP1, PORT1), (IPm, 0)}
S9504
RSVP · RESV {(IP1, PORT1), (IPm, 0)}
S9505
ISOCHRONOUS CHANNEL NUMBER RESERVATION (#z)
S9506
BANDWIDTH RESERVATION (y1)
S9507
FANP OFFER, DESTINATION=IPm,
FLOW= {(IP1, PORT1), (IPm, 0)}, LAYER-2 ID=# z
S9508
IP MULTICAST DATA (THROUGH #z), DESTINATION=IPm,
FRAGMENT SOURCE=FW1 (THROUGH ISOCHRONOUS CHANNEL)
S9509
IP MULTICAST DATA (THROUGH #x), DESTINATION=IPm,
FRAGMENT SOURCE=FW2 (THROUGH ASYNCHRONOUS CHANNEL)

FIG.83

DATA TRANSMITTING NODE AND NETWORK INTER-CONNECTION NODE SUITABLE FOR HOME NETWORK ENVIRONMENT

This is a continuation-in-part application of our earlier commonly assigned application Ser. No. 08/943,927 filed Oct. 3, 1997, which is now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a network system for constructing a home network environment, and more particularly, to a data transmitting node and a network inter-connection node suitable for use in the home network environment.

2. Description of the Background Art

In recent years, there is a rapid trend for digitalizing electronic instruments as exemplified by the term "multimedia", and this trend is already noticeable in the office environment.

More specifically, in terms of hardware, this trend has been materialized in forms of introduction of PCs, digitalization of OA devices and formation of networks among them. Also, in terms of software, this trend has been expanding to cover the basic functions of hosts (which are progressively light-sized and transferred to PCs), the application software such as the word-processing software, the spreadsheet software, etc., and the Internet application such as the WWW.

The similar trend can also be seen in the home environment. Namely, even in the home environment, this trend for digitalization has been steadily progressed in forms of digitalization of AV devices (DVD, digital VTR, digital video camera, etc.), digitalization of broadcasting, and Internet access such as OCN.

Similarly as in a case of the office environment, this trend is expected to progress toward the formation of networks in future. Namely, it is expected that the technologies of various fields such as information processing, communication and broadcasting will be unified by the digitalization, and inter-mixed with each other by the formation of networks.

There are many candidates for the network technologies in this direction. For example, the Ethernet has overwhelming records of the actual use in the office environment and is probably the most promising candidate even for the home PC network. Also, the ATM is another serious contender because of the general consensus among the infra-structure constructors (telephone companies, CATV companies, etc.) to keep constructing the infra-structures based on this technology in view of the advantageous characteristics of the ATM such as its fast, real-time, and wide bandwidth properties.

In addition to these candidates, the network technology (bus technology) called IEEE 1394 has been attracting much attentions recently. This IEEE 1394 has several remarkable characteristics such as its fast, real-time (QOS guaranteed), and plug-and-play properties, so that there is a high expectation especially among the AV industries on the IEEE 1394 as the most promising candidate for a future scheme for inter-connecting digital AV devices. This vogue has also instigated much interests to the IEEE 1394 from the computer industries as well.

In the initial phase, it is expected that the inter-connection of the home use digital devices will be realized by these various network technologies in conjunction with the spread of-the home use digital devices, depending on preferences and demands of the users, and in this way prototype digital networks will be gradually built up inside each home.

In the second phase, there will be demands for inter-connecting these digital networks together. For example, there will be a desire to inter-connect an AV device connected to the 1394 network of a guest room on the first floor with another AV device connected to the 1394 network of a private room on the second floor in order to realize the dubbing or the cooperative operation between these AV devices.

However, in order to meet the expected demands of this second phase, the following problems must be addressed and resolved.

(1) The 1394 network is not suited for a large scale installation. For example, its cable length is limited to 4.5 m, so that the wiring across rooms will be difficult. Also, the plug-and-play function of the 1394 has the side-effect that the on-going communication will be instantaneously disconnected whenever someone connects to or disconnects from the 1394. When the wiring of the 1394 across rooms is attempted, there will be an inconveniency in that an action made in one room would affect another room in a form of the instantaneous disconnection of the on-going communication because of its "bus reset".

(2) The standardization of the specification for "1394 bridge" as the inter-connection protocol/scheme for the 1394 is currently in progress at the IEEE which is the standardization committee for the 1394. However, the standard specification is expected to be a very complicated one that requires the scalability and incorporates a concept of call set up, and it is also expected that a considerable amount of time will be needed before the standard specification can be solidified.

(3) The home network will not necessarily be limited to just the 1394, so that it is preferable to construct the home network according to a scheme that can inter-connect various types of networks. However, no such a network architecture has been proposed so far.

(4) As a known technique for inter-connecting various networks, there is the Internet protocol. However, this scheme is difficult to set up, manage and maintain for the layman, and it also requires the server management, so that in its currently available form it is not suitable for an inter-connection scheme intended for use in the home network which is expected to deal with a rather limited number of terminals.

On the other hand, in recent years, rapid progresses made in the communication technology such as Internet are attracting much attentions from various fields, and issues such as introduction of LAN or connection of that to WAN or Internet are much discussed mainly among companies and universities.

These technological innovations are highly likely to change the network environment surrounding our homes. Namely, with the spread of various digital devices such as PC, DVD, digital set-top box and so on in our homes, demands for inter-connecting them through a digital network inevitably arises. Currently, IEEE 1394 bus is attracting much attentions from various fields, especially among AV vendors, as a prime candidate for such a digital network for home use.

This IEEE 1394 bus can be used as a high speed digital network of 100, 200 or 400 Mbps, and has several remarkable characteristics including plug-and-play properties, syn-

chronous transfer function using isochronous channel, etc., as already mentioned above.

Meanwhile, rapid technological innovations are also made in the so called access network for homes. Namely, notable progresses have been made in high speed network technologies such as CATV, ADSL (Asymmetric Digital Subscriber Line) and FTTH (Fiber-To-The-Home) as well as network services such as Internet, and so on. In particular, the Internet technology has promoted many remarkable techniques including its fast implementation, guarantee of QOS (Quality Of Service) using network layer level signaling protocol such as RSVP (Resource Reservation Protocol), multicast, and so on.

In near future where these techniques are realized on Internet, transfer of some information that require high speed and realtime characteristics such as video transfer to homes may very well be carried out through Internet. This is because Internet can store virtually infinite amount of information so that it is only natural for Internet users to come to expect acquisition through Internet of the above noted information which has conventionally been acquired from terrestrial or satellite broadcasting and the like.

However, when exchanges of information through Internet are attempted by connecting home digital devices through the access network, the following problems will be encountered.

(1) Currently, a scheme for distributing Internet data over IEEE 1394, i.e., IP-over-1394, is discussed by various groups, but these discussions still remain at a level of the so called address resolution scheme. On the other hand, there is a proposition of a signaling protocol such as RSVP for carrying out data exchanges with guaranteed communication quality on Internet. However, a scheme for operating such a network layer signaling protocol on IEEE 1394 has not been standardized so that mapping to a transfer scheme that does not guarantee communication quality is the only available option for IEEE 1394.

Consequently, even when the above noted signaling protocol is executed, data will be transferred over IEEE 1394 on the best effort basis (more specifically, through asynchronous channel) so that the end-to-end communication quality cannot be guaranteed.

(2) In the case of transmission and reception of IP multicast on IEEE 1394 bus, the use of isochronous channel or asynchronous stream of IEEE 1394 can be considered in order to minimize traffic on IEEE 1394 bus. However, when two or more devices tries to subscribe for the same IP multicast at the same time, there is a possibility for these two or more devices to reserve different channels separately so that the efficient utilization of communication resource cannot be realized.

Moreover, there is no mechanism for enabling synchronized recognition of correspondence between reserved channel and IP multicast address by a transmitting side and a receiving side.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a data transmitting node and a network inter-connection node which are capable of resolving the above noted problems and which are therefore suitable for use in the home network environment.

It is another object of the present invention to provide a communication device capable of realizing communication that guarantees communication quality in an inter-connected network environment even on IEEE 1394, by specifying a scheme for applying RSVP to IEEE 1394 bus.

It is another object of the present invention to provide a communication device capable of carrying out IP multicast by utilizing communication resource efficiently, and enabling recognition of correspondence between reserved channel and IP multicast address by a transmitting side and a receiving side in synchronization, in a network of broadcast type such as IEEE 1394.

According to one aspect of the present invention, there is provided a data transmitting node connected with a physical network, comprising: a first transmission unit for transmitting a control message in a case of transmitting information data to a receiving node through connected with the physical network or another physical network, the control message including an IP address information of a data transmission destination, a header/channel information dependent on the physical network, and an information indicating that the information data to be transmitted according to the header/channel information is data in an upper layer of an IP layer; and a second transmission unit for transmitting the information data to the receiving node, the information data containing the header/channel information and data of the upper layer without IP packet encapsulation.

In this aspect of the present invention, it becomes possible to explicitly notify a network connection device on a communication path that the information data that pass through a communication path established by the control message are not IP packets so that they should be forwarded by a datalink layer processing alone without forwarding them to the so called IP processing unit for carrying out the routing processing of IP packets.

Namely, by notifying a header/channel information according to which the information data is to be transmitted later and an IP address of the receiving node to the network connection device, it becomes possible to notify that a transfer destination of the subsequently transmitted information data which has this header/channel information (datalink layer identifier) is the IP address of the receiving node, so that the network connection device on the communication path can establish the communication path (datalink layer communication path) up to the receiving node at the datalink layer level.

In addition, by using the IP address, it becomes possible to realize an address system which can be commonly used even under an environment in which a plurality of types of physical networks are inter-connected, so that it becomes possible to carry out the data transmission and the control message transmission with respect to nodes belonging to physical networks of different transmission schemes.

Moreover, it is possible to explicitly notify the network connection device that the information data that pass through the communication path are not IP packets but the packets in the upper layer than the IP layer, so that it can be expected that the network connection device will transfer the information data on the communication path to the receiving node without applying the so called IP routing processing, and therefore it becomes possible to realize the transmission of the so called raw data such as MPEG video and speech data.

Also, in this aspect of the present invention, the control message may command to a network inter-connection node for connecting said physical network and a next physical network a registration of a correspondence between the header/channel information dependent on said physical network and a header/channel information dependent on the next physical network.

This defines the operation of the control message in this aspect of the present invention.

Also, in this aspect of the present invention, the data transmitting node may further comprises: a reception unit for receiving digital video and/or digital audio data; wherein the second transmission unit transmits the digital video and/or digital audio data received by the reception unit as the information data, by formatting the digital video and/or digital audio data into a transmission format for said physical network.

In this aspect of the present invention, in a case of receiving the raw or MPEG coded video/speech data and forwarding the received data to a specific receiving node, as in a case of a set-top box for the digital satellite broadcast, the digital CATV, or the digital terrestrial broadcast, it becomes possible to realize this data forwarding by formatting the received data into a format of a physical network.

According to another aspect of the present invention, there is provided a network inter-connection node for transmitting information data received from one physical network to another physical network, comprising: a reception unit for receiving a first control message from said one physical network, the first control message containing an IP address information of a data transmission destination, a first header/channel information dependent on said one physical network, and an information indicating that an information data to be transmitted according to the first header/channel information is data in an upper layer of a protocol layer corresponding to the IP address information; a first transmission unit for transmitting a second control message to said another physical network when the reception unit receives the first control message, the second control message containing the IP address information, a second header/channel information dependent on said another physical network which is obtained from the IP address information, and the information indicating that the information data to be transmitted according to the second header/channel information is data in the upper layer; a memory unit for storing a correspondence between the first header/channel information and the second header/channel information; and a second transmission unit for obtaining the second header/channel information corresponding to the first header/channel information according to the correspondence stored in the memory unit when the information data containing the first header/channel information is received from said one physical network, attaching the second header/channel information to the information data, and transmitting the information data to said another physical network, the information data containing data of the upper layer without IP packet encapsulation.

In this aspect of the present invention, the information data containing the first header/channel information are the packets in the upper layer than the IP layer. Consequently, each network connection device on the communication path can recognize that the information data that pass through a communication path established by the control message are not IP packets so that there should be a setting by which they can be forwarded by a datalink layer processing alone without forwarding them to the so called IP processing unit for carrying out the routing processing of IP packets, and make this setting to the second transmission unit. As a result, it becomes possible to realize a transfer of arbitrary data such as MPEG video and speech data in the IP network environment.

Also, in this aspect of the present invention, the first control message may command a registration of a correspondence between the first header/channel information and the second header/channel information, and the second control message may command to a receiving node or a network inter-connection node for connecting said another physical network and a third physical network a registration of a correspondence between the second header/channel information and a header/channel information dependent on said third physical network.

This defines the operations of the first and second control messages in this aspect of the present invention.

According to another aspect of the present invention, there is provided a data transmitting node connected with a physical network, comprising: a first transmission unit for transmitting a control message in a case of transmitting information data to a receiving node connected with the physical network or another physical network, the control message including an IP address information of a data transmission destination, a header/channel information dependent on the physical network, and an information indicating a required communication resource; and a second transmission unit for transmitting the information data containing the header/channel information for which the required communication resource is reserved, to the receiving node.

In this aspect of the present invention, it becomes possible to explicitly notify a network connection device on a communication path that the information data that pass through a communication path established by the control message are requiring this much of the communication resource amounts so that this communication resource amounts should be reserved in a case of acquiring the communication resources (connections, channels, etc.) of the datalink that constitutes this communication path.

In addition, the IP address is used as an address system so that it can be realized under the inter-connection environment of arbitrary combination of mutually different datalink layers and therefore it becomes possible to establish the communication path while reserving the communication resources under an arbitrary inter-connected network environment.

Also, in this aspect of the present invention, the control message may command to a network inter-connection node for connecting said physical network and a next physical network a registration of a correspondence between the header/channel information dependent on said physical network and a header/channel information dependent on the next physical network for which the required communication resource is reserved.

This defines the operation of the control message in this aspect of the present invention.

Also, in this aspect of the present invention, the data transmitting node may further comprises: a reception unit for receiving digital video and/or digital audio data; wherein the second transmission unit transmits the digital video and/or digital audio data received by the reception unit as the information data, by formatting the digital video and/or digital audio data into a transmission format for said physical network.

In this aspect of the present invention, in a case of receiving the raw or MPEG coded video/speech data and forwarding the received data to a specific receiving node, as in a case of a set-top box for the digital satellite broadcast, the digital CATV, or the digital terrestrial broadcast, it becomes possible to realize this data forwarding by formatting the received data into a format of a physical network.

According to another aspect of the present invention, there is provided a network inter-connection node for trans-

mitting information data received from one physical network to another physical network, comprising: a reception unit for receiving a first control message from said one physical network, the first control message containing an IP address information of a data transmission destination, a first header/channel information dependent on said one physical network, and an information indicating a required communication resource; a first transmission unit for transmitting a second control message to said another physical network when the reception unit receives the first control message, the second control message containing a second header/channel information dependent on said another physical network which is obtained from the IP address information, and the information indicating the required communication resource; an establishing unit for establishing a communication path with respect to a receiving node or a next network inter-connection node for connecting said another physical network and a third physical network, the communication path having the second header/channel information with the required communication resource; a memory unit for storing a correspondence between the first header/channel information and the second header/channel information; and a second transmission unit for obtaining the second header/channel information corresponding to the first header/channel information according to the correspondence stored in the memory unit when the information data containing the first header/channel information is received from said one physical network, attaching the second header/channel information to the information data, and transmitting the information data to said another physical network.

In this aspect of the present invention, each network connection device on the communication path can recognize that the information data that pass through a communication path established by the control message are requiring this much of the communication resource amounts so that this communication resource amounts should be reserved in a case of acquiring the communication resources (connections, channels, etc.) of the datalink that constitutes this communication path, establish the datalink layer connection having this communication resource amounts by the establishing unit, and make a corresponding setting to the second transmission unit.

In addition, the IP address is used as an address system so that it can be realized under the inter-connection environment of arbitrary combination of mutually different datalink layers and therefore it becomes possible to establish the communication path while reserving the communication resources under an arbitrary inter-connected network environment.

Also, in this aspect of the present invention, the first control message may command a registration of a correspondence between the first header/channel information and the second header/channel information, and the second control message may command to the receiving node or the next network inter-connection node a registration of a correspondence between the second header/channel information and a header/channel information dependent on said third physical network.

This defines the operations of the first and second control messages in this aspect of the present invention.

According to another aspect of the present invention, there is provided a data transmitting node connected with a physical network, comprising: a first transmission unit for transmitting a control message in a case of transmitting information data to a receiving node connected with the physical network or another physical network, the control message including an IP address information of a data transmission destination, a header/channel information dependent on the physical network, and an information on a format of the information data to be transmitted according to the header/channel information; and a second transmission unit for transmitting the information data in said format which contains the header/channel information, to the receiving node.

In this aspect of the present invention, it becomes possible to explicitly notify a network connection device on a communication path that the information data that pass through a communication path established by the control message will be in this format (such as MPEG, JPEG, etc.) so that they should be forwarded by a datalink layer processing alone without forwarding them to the so called IP processing unit for carrying out the routing processing of IP packets, and a transfer according to the format transfer scheme depending on the datalink layer of a transfer target physical network should be made.

For example, in a case of MPEG, it becomes possible to urge the setting by which the MPEG data can be transferred in a format depending on the datalink layer, such as "MPEG-over-ATM" defined by the ATM forum in while being transferred through the ATM network, and "MPEG-over-1394" defined by the IEC 61883 while being transferred through the IEEE 1394 bus.

Also, in this aspect of the present invention, the control message may command to a network inter-connection node for connecting said physical network and a next physical network a registration of a correspondence between the header/channel information dependent on said physical network and the header/channel information dependent on the next physical network.

This defines the operation of the control message in this aspect of the present invention.

Also, in this aspect of the present invention, the data transmitting node may further comprises: a reception unit for receiving digital video and/or digital audio data; wherein the second transmission unit transmits the digital video and/or digital audio data received by the reception unit as the information data, by formatting the digital video and/or digital audio data into said format.

In this aspect of the present invention, in a case of receiving the raw or MPEG coded video/speech data and forwarding the received data to a specific receiving node, as in a case of a set-top box for the digital satellite broadcast, the digital CATV, or the digital terrestrial broadcast, it becomes possible to realize this data forwarding by formatting the received data into a format of a physical network.

According to another aspect of the present invention, there is provided a network inter-connection node for transmitting information data received from one physical network to another physical network, comprising: a reception unit for receiving a first control message from said one physical network, the first control message containing an address information of a data transmission destination, a first header/channel information dependent on said one physical network, and an information on a format of the information data to be transmitted according to the first header/channel information; a first transmission unit for transmitting a second control message to said another physical network when the reception unit receives the first control message, the second control message containing the address information, a second header/channel information dependent on said another physical network which is obtained

from the address information, and the information on a format of the information data to be transmitted according to the second header/channel information; a memory unit for storing a correspondence between the first header/channel information and the second header/channel information; a conversion unit for converting a transmission format of the information data to be transmitted from a transmission format in the said one physical network to a transmission format in said another physical network; and a second transmission unit for obtaining the second header/channel information corresponding to the first header/channel information according to the correspondence stored in the memory unit when the information data containing the first header/channel information is received from said one physical network, attaching the second header/channel information to the information data, and transmitting the information data to said another physical network.

In this aspect of the present invention, each network connection device on the communication path can recognize that the information data that pass through a communication path established by the control message will be in this format (such as MPEG, JPEG, etc.) so that they should be forwarded by a datalink layer processing alone without forwarding them to the so called IP processing unit for carrying out the routing processing of IP packets, and there is a need to carry out the format conversion in order to transfer according to the format transfer scheme depending on the datalink layer of a transfer target physical network, and make necessary settings to the conversion unit and the second transmission unit.

Also, in this aspect of the present invention, the first control message may command a registration of a correspondence between the first header/channel information and the second header/channel information, and the second control message may command to a receiving node or a network inter-connection node for connecting said another physical network and a third physical network a registration of a correspondence between the second header/channel information and a header/channel information dependent on said third physical network.

This defines the operations of the first and second control messages in this aspect of the present invention.

Also, in this aspect of the present invention, the information data to be transmitted by the second transmission unit may be MPEG data, and the conversion unit may convert the transmission format of the MPEG data from a transmission format for the MPEG data in said one physical network to a transmission format for the MPEG data in said another physical network.

In this aspect of the present invention, by this format conversion by the conversion unit, it becomes possible to transfer the MPEG data in a format depending on the datalink layer, such as "MPEG-over-ATM" defined by the ATM forum in while being transferred through the ATM network, and "MPEG-over-1394" defined by the IEC 61883 while being transferred through the IEEE 1394 bus.

According to another aspect of the present invention, there is provided a data transmitting node connected with an IEEE 1394 bus, comprising: a first transmission unit for transmitting a control message in a case of transmitting information data to a receiving node connected with another physical network, the control message including an address information of a data transmission destination, and an isochronous channel number or a register offset indicating an isochronous channel of said IEEE 1394 bus; and a second transmission unit for transmitting the information data in forms of IEEE 1394 packets containing the isochronous channel number or the register offset, onto the isochronous channel.

In this aspect of the present invention, it becomes possible to explicitly notify a transfer target of the received data to a network connection device on a communication path connected to the IEEE 1394 bus, in such a manner that the information data entering from that isochronous channel number at the IEEE 1394 interface to which this control message is entered will be data destined to that data transmission destination address.

In addition, it also becomes possible to explicitly notify that the information data that pass through that isochronous channel should be forwarded to a next hop network channel by a datalink layer processing alone without forwarding them to the so called IP processing unit for carrying out the routing processing of IP packets.

Also, in this aspect of the present invention, the control message may command to a network inter-connection node for connecting said IEEE 1394 bus and a next physical network a registration of a correspondence between the isochronous channel number of the register offset and a header/channel information dependent on the next physical network.

This defines the operation of the control message in this aspect of the present invention.

Also, in this aspect of the present invention, the data transmitting node may further comprises: a reception unit for receiving digital video and/or digital audio data; wherein the second transmission unit transmits the digital video and/or digital audio data received by the reception unit as the information data, by formatting the digital video and/or digital audio data into an IEEE 1394 transmission format.

In this aspect of the present invention, in a case of receiving the raw or MPEG coded video/speech data and forwarding the received data to a specific receiving node, as in a case of a set-top box for the digital satellite broadcast, the digital CATV, or the digital terrestrial broadcast, it becomes possible to realize this data forwarding by formatting the received data into a format of a physical network.

According to another aspect of the present invention, there is provided a network inter-connection node for connecting at least two physical networks including an IEEE 1394 bus and transmitting an information data received from one physical network to another physical network, comprising: a reception unit for receiving a first control message from said one physical network, the first control message containing an address information of a data transmission destination, and a first header/channel information dependent on said one physical network; a first transmission unit for transmitting a second control message to said another physical network when the reception unit receives the first control message, the second control message containing the address information and a second header/channel information dependent on said another physical network which is obtained from the address information; a memory unit for storing a correspondence between the first header/channel information and the second header/channel information, at least one of the first header/channel information and the second header/channel information including an isochronous channel number or a register offset indicating an isochronous channel of the IEEE 1394 bus; and a second transmission unit for obtaining the second header/channel information corresponding to the first header/channel information according to the correspondence stored in the memory unit when the information data containing the first

header/channel information is received from said one physical network, attaching the second header/channel information to the information data, and transmitting the information data to said another physical network.

In this aspect of the present invention, it becomes possible to carry out the transmission of arbitrary data with respect to the receiving node belonging to arbitrary distanced network (a physical network to which the transmitting node does not belongs), under the environment in which the 1394 buses or the 1394 bus and arbitrary physical network are inter-connected.

Namely, in the inter-connected networks in which the 1394 buses or the 1394 bus and arbitrary physical network are inter-connected, it is possible to ascertain the destination node ID or channel number and the destination address of the destination node (which can be the network layer address such as IP address or the datalink layer address such as 1394 address or MAC address) which are the header information of the first physical network to which the data will be transferred later, from the neighboring node on the side of the IEEE 1394 bus which is the first physical network. Then, from this information, it is possible to notify a correspondence between the header/channel information to be used at the second physical network (virtual connection identifier, or destination node ID or channel number, or MAC address, etc., in the second physical network) and the destination address (the address information), to the neighboring node on the second physical network side (or conversely, the information from the second physical network side is notified to the first physical network side).

In addition, by referring to the header/channel information (channel number, destination node ID, virtual connection identifier, MAC address, etc.) of one physical network alone, it becomes possible to transfer the data by attaching (or converting) the header/channel information (channel number, destination node ID, virtual connection identifier, MAC address, etc.) of another physical network, so that the considerably fast processing becomes possible even between the 1394 bus and the other arbitrary physical network.

Moreover, at least one of the first header/channel information and the second header/channel information includes an isochronous channel number or a register offset indicating an isochronous channel of the IEEE 1394 bus, so that it becomes possible for the relay device to directly convert the isochronous channel number of the IEEE 1394 bus to the header/channel information (virtual connection identifier, isochronous channel number, MAC address, etc.) of the (another) second physical network (or vice versa). Consequently, especially in a case where the end-to-end data transfer by the datalink layer switching is desired as in a case of the transfer of data that requires the communication quality, it becomes possible to realize this data transfer by using the isochronous channel of the IEEE 1394 bus and using the channel number in a similar manner as the virtual connection identifier (such as VPI/VCI of the ATM).

Also, in this aspect of the present invention, said another physical network may be an Ethernet or a token ring or a FDDI, and the second header/channel information may indicate a MAC address.

Also, in this aspect of the present invention, said one physical network may be an Ethernet or a token ring or a FDDI, and the first header/channel information may indicate a MAC address.

In these cases, it becomes possible to recognize the header value and its attribute and communication quality on the 1394 bus side by providing the correspondence table and the conversion table based on the MAC address value, or conversely, to recognize the header information value (header/channel information depending on the second physical network) on the second physical network (another physical network) side and its attribute and communication quality by providing the table based on the header information value of the 1394 bus. Consequently, it becomes possible to carry out the data forwarding to the facing network side by the datalink layer processing alone, and the fast forwarding processing becomes possible. For this reason, it becomes possible to use the various frame schemes using MAC address as the transmission scheme of the second physical network.

Also, in this aspect of the present invention, said another physical network may be an ATM network, and the second header/channel information may indicate a VPI/VCI.

Also, in this aspect of the present invention, said one physical network may be an ATM network, and the first header/channel information may indicate a VPI/VCI.

In these cases, it becomes possible to recognize the header value and its attribute and communication quality on the 1394 bus side by providing the correspondence table and the conversion table based on the VPI/VCI value, or conversely, to recognize a value of the VPI/VCI value (header/channel information depending on the second physical network) and its attribute and communication quality by providing the table based on the header information value of the 1394 bus. Consequently, it becomes possible to carry out the data forwarding to the facing network side by the datalink layer processing alone, and the fast forwarding processing becomes possible. For this reason, it becomes possible to use the ATM as the transmission scheme of the second physical network (another physical network).

According to another aspect of the present invention, there is provided a data transmitting node connected with a network, comprising: a first transmission unit for transmitting a control message in a case of transmitting information data to a receiving node connected with another network, the control message including a first MAC address information of a data transmission destination, and a second MAC address information to be attached to the information data; and a second transmission unit for transmitting the information data containing the second MAC address information, to the receiving node.

In this aspect of the present invention, it becomes possible to explicitly notify a transfer target of the received data to a network connection device on a communication path, in such a manner that the information data entering with that second MAC address at the physical network interface to which this control message is entered will be data destined to that data transmission destination first MAC address.

In addition, it also becomes possible to explicitly notify that, for the information data entered with that second MAC address, the similar control message exchange is to be carried out at the subsequent hops and the packet/frame routing should be carried out by referring to the MAC address alone.

Also, in this aspect of the present invention, the control message may command to a network inter-connection node for connecting said network and a next network a registration of a correspondence between the second MAC address information and a header/channel information dependent on the next network.

This defines the operation of the control message in this aspect of the present invention.

Also, in this aspect of the present invention, the data transmitting node may further comprises: a reception unit for receiving digital video and/or digital audio data; wherein the second transmission unit transmits the digital video and/or digital audio data received by the reception unit as the information data, by formatting the digital video and/or digital audio data into a transmission format for said network.

In this aspect of the present invention, in a case of receiving the raw or MPEG coded video/speech data and forwarding the received data to a specific receiving node, as in a case of a set-top box for the digital satellite broadcast, the digital CATV, or the digital terrestrial broadcast, it becomes possible to realize this data forwarding by formatting the received data into a format of a physical network.

According to another aspect of the present invention, there is provided a network inter-connection node for transmitting information data received from one network to another network, comprising: a reception unit for receiving a first control message from said one network, the first control message containing a first MAC address information of a data transmission destination, and a second MAC address information; a first transmission unit for transmitting a second control message to said another network when the reception unit receives the first control message, the second control message containing the first MAC address information, and a third MAC address information which is obtained from the first MAC address information; a memory unit for storing a correspondence between the second MAC address information and the third MAC address information; and a second transmission unit for obtaining the third MAC address information corresponding to the second MAC address information according to the correspondence stored in the memory unit when the information data containing the second MAC address information is received from said one network, attaching the third MAC address information to the information data, and transmitting the information data to said another network.

In this aspect of the present invention, in the bridge network in which two or more physical networks are interconnected, it is possible to ascertain the header information (the destination MAC address in the first physical network) of the first physical network (one physical network) to which the data will be transferred later and the destination address of its destination node (the MAC address information: the final destination MAC address), from the neighboring node of the previous hop. Then, from this information, it is possible to notify a correspondence between the header information (the destination MAC address in the second physical network) to be used at the second physical network (another physical network) and the destination address (the MAC address information: the final destination MAC address), to the neighboring node.

In addition, by referring to the header information (the destination MAC address in the first physical network) of said physical network alone, it becomes possible to transfer the data by attaching (or converting) the header information (MAC address) of the second physical network, so that the considerably fast processing becomes possible even between different types of networks. Here, the MAC address may be used as a logical value, that is, as the virtual connection identifier.

According to another aspect of the present invention, there is provided a network inter-connection node for connecting at least two physical networks, comprising: a request receiving unit for receiving from a first physical network an address resolution request for resolving a datalink layer address from a network layer address; a forwarding unit for forwarding the address resolution request with respect to a connected physical network other than the first physical network; a response receiving unit for receiving from a second physical network a first address resolution response corresponding to the address resolution request forwarded by the forwarding unit; a registration unit for registering a correspondence between the network layer address and the second physical network into a routing table, by referring to a network layer source address or a network address contained in the first address resolution response; and a response transmitting unit for transmitting to the first physical network a second address resolution response corresponding to the address resolution request received by the request receiving unit, by inserting a datalink layer address of said network inter-connection node device as a resolved address.

In this aspect of the present invention, when the first physical network and the second physical network are the networks using different address systems (such as the Ethernet and the IEEE 1394, for example), or when they are networks using the same address system which are however connected without using a bridge connection, it becomes possible to carry out a delivery of a packet to a desired node by specifying an address of this network inter-connection node as a packet destination with respect to a node which transmitted the address resolution request and carrying out the routing of a packet received at this network inter-connection node.

In addition, in this aspect of the present invention, the network layer address learning function is provided, so that it is possible to deal with a case where an entry or withdrawal of a node with respect to a network is to be made dynamically.

Also, in this aspect of the present invention, the network inter-connection node device may further comprises a transfer unit for transferring a received packet to a physical network registered in the routing table, according to a network layer destination address of the received packet.

Also, in this aspect of the present invention, the response transmitting unit may activate the forwarding unit when a network layer address contained in the address resolution request received from the first physical network is not a network layer address of said network inter-connection node device and not registered in the routing table, and transmit the second address resolution response otherwise.

Also, in this aspect of the present invention, the first physical network and the second physical network may be operated by different datalink protocols.

According to another aspect of the present invention there is provided unication device connected with a network of broadcast type (such as IEEE 1394), comprising: a reception unit for receiving a first message which is a control message for bandwidth reservation with respect to a network layer data flow, including a first identifier for identifying the network layer data flow, from a second communication device connected with the network; an establishing unit for establishing a broadcast type channel (such as isochronous channel or asynchronous stream of IEEE 1394) on the network according to the first message received by the reception unit; and a transmission unit for transmitting a second message which contains at least a correspondence between a second identifier of the broadcast type channel established by the establishing unit and the first identifier of the network layer data flow, to the second communication device.

In this aspect of the present invention, in a control protocol for bandwidth reservation with respect to a network layer data flow such as RSVP in Internet, a node which received a control message (first message, which is PATH message or RESV message in the case of RSVP) reserves a broadcast type channel (such as isochronous channel or asynchronous stream of IEEE 1394) on that network, so that it is possible to reserve the required communication resource in a form of the broadcast type channel, and it becomes possible to realize communication with end-to-end communication resource reserved as should be realized by the network layer level signaling protocol.

In addition, the second message can also be used for realizing transfer to a next hop network without requiring a routing processing in the network layer, by referring only to a datalink transfer at a network boundary, that is an identifier of a datalink layer (such as an identifier of the broadcast type channel), and indirectly recognizing the network layer flow transferred by a channel having that identifier. The second message can also be used by a downstream node to prepare for receiving of the network layer flow from that channel, or by an upstream node to prepare for transmission of the network layer flow to that channel.

Also, in this aspect of the present invention, the first message may be a message for requesting bandwidth reservation, which is transmitted from the second communication device connected to a downstream direction of the network layer data flow.

In this case, an upstream side node of the network layer flow can realize the bandwidth reservation in a form of bandwidth resource reservation for the broadcast type network. Namely, an upstream side node of the network layer flow can realize this bandwidth reservation in response to a bandwidth reservation request from a downstream direction, as in a case of receiving RESV of RSVP as the first message.

Also, in this aspect of the present invention, the first message may be a message for notifying bandwidth to be used, which is transmitted from the second communication device connected to an upstream direction of the network layer data flow.

In this case, a downstream side node of the network layer flow can realize the bandwidth reservation in a form of bandwidth resource reservation for the broadcast type network. Namely, a downstream side node of the network layer flow can realize this bandwidth reservation in response to a control message for bandwidth reservation from an upstream direction, as in a case of receiving PATH of RSVP as the first message.

Also, in this aspect of the present invention, the communication device may further comprises: a second transmission unit for transmitting a message for requesting bandwidth reservation to the second communication device which is connected to an upstream direction of the network layer data flow.

In this case, it becomes possible to transmit a message for bandwidth reservation in the network layer such as RESV message of RSVP to the second communication device of the upstream side, so that it becomes possible to realize the end-to-end bandwidth reservation.

Also, in this aspect of the present invention, the transmission unit may transmit the second message in a form of writing into a register provided at the second communication device.

In this case, it becomes possible to realize a notification of the correspondence between the identifier of the established broadcast type channel and the identifier of the network layer data flow in a form of writing into register, which is a generally known means for transmitting control information in a network of broadcast type such as IEEE 1394. This correspondence is an information regarding the datalink layer channel, so that it is appropriate to use a register for transmitting datalink layer control information, and it becomes unnecessary to provide a mechanism for receiving and interpreting this correspondence in the network layer.

According to another aspect of the present invention, there is provided a communication device connected with a network of broadcast type, comprising: a register for registering a correspondence between an identifier of a broadcast type channel established on the network which is to be used in transmitting and receiving a network layer data flow and an identifier of the network layer data flow; and a transmission and/or reception unit for transmitting and/or receiving the network layer data flow through the broadcast type channel according to the correspondence registered in the register.

In this aspect of the present invention, it becomes possible to notify to another node or obtain from another node a correspondence between a broadcast type channel identifier of a broadcast type network (such as IEEE 1394) described in this register and an information regarding a flow that passes through that channel. This correspondence is an information regarding the datalink layer channel, so that it is appropriate to use a register for transmitting datalink layer control information, and it becomes unnecessary to provide a mechanism for receiving and interpreting this correspondence in the network layer.

By using this register, when a node having this register is a transmitting node, it becomes possible for another node of the broadcast type network to recognize which flow is going to be transferred through the broadcast type channel of the broadcast type network described in this register (which flow is to be transmitted by the transmitting node), by referring to this register.

Also, when a node having this register is a transmitting node, it becomes possible for this transmitting node to recognize which flow is going to be transferred through the broadcast channel of the broadcast type network described in this register (which flow is to be transmitted by the transmitting node), as another node of the broadcast type network writes the correspondence into this register.

Also, when a node having this register is a receiving node, it becomes possible for this receiving node to recognize which flow is going to be transferred through the broadcast channel of the broadcast type network described in this register (which flow is to be received by the receiving node), as another node of the broadcast type network writes the correspondence into this register.

Also, this register may have a field for distinguishing transmission and reception. By means of this, it becomes possible to clearly indicate whether this register is to be used by the transmitting node or the receiving node.

According to another aspect of the present invention, there is provided a communication device connected with a network of broadcast type, comprising: a reception unit for receiving a subscription request for a network layer multicast address from a second communication device connected with the network; an establishing unit for establishing a broadcast type channel on the network in response to the subscription request received by the reception unit; a notification unit for notifying at least a correspondence between an identifier of the broadcast type channel established by the

establishing unit and the network layer multicast address, to the second communication device; and a transmission unit for transmitting data destined to the network layer multicast address to the broadcast type channel established by the establishing unit.

In this aspect of the present invention, the isochronous channel for transmitting the corresponding network layer multicast is established by an IGMP router which receives the subscription request for that multicast address, so that it becomes possible to prevent communication resource within the network from being wasted by establishing a plurality of channels with respect to the identical multicast address.

Also, by notifying the correspondence between the identifier of the established broadcast type channel and the network layer multicast address to the second communication device, it becomes possible to notify a channel from which the multicast data can be received to the second communication device (receiving terminal), and in addition it becomes possible to accommodate a plurality of receiving terminals through a single channel because the broadcast type channel is used.

Also, in this aspect of the present invention, the communication device may further comprises: a second reception unit for receiving from the second communication device a request for reservation of bandwidth required in receiving the data destined to the network layer multicast address from the second communication device; and a reservation unit for reserving bandwidth of the broadcast type channel established by the establishing unit in response to the request received by the second reception unit.

In this case, it becomes possible to realize the transmission in a form that guarantees communication quality of the multicast.

According to another aspect of the present invention, there is provided a communication device, connected with a network of broadcast type, for transmitting data destined to a network layer multicast address, comprising: a reservation unit for reserving bandwidth for a broadcast type channel; a first transmission unit for transmitting the data destined to the network layer multicast address by using a period or connection for which the bandwidth of the broadcast type channel on the network is not reserved; and a second transmission unit for transmitting the data destined to the network layer multicast address by switching the period or connection used in the first transmission unit to a period or connection for which the bandwidth of the broadcast type channel is reserved, when the bandwidth is reserved for the broadcast type channel by the reservation unit.

In this aspect of the present invention, in a case of switching the network layer multicast packet transmission from a form of not reserving bandwidth to a form of reserving bandwidth, it becomes unnecessary to request the reservation of both the broadcast type channel and the bandwidth to a manager which is managing communication resource (such as isochronous resource manager in IEEE 1394) again, as required conventionally. Namely, it is possible to realize this switching by simply sending packets for the broadcast type channel that is already reserved as communication resource into the first transmission unit. The same also applies to the switching in the reserve direction (from a form of reserving bandwidth to a form of not reserving bandwidth).

Also, in this aspect of the present invention, an identifier of the broadcast type channel to which the data are outputted from the second transmission unit when the bandwidth is reserved by the reservation unit may be identical to an identifier of the broadcast type channel to which the data are outputted from the first transmission unit when the bandwidth is not reserved.

In this case, it becomes possible to prevent wasteful use of the broadcast type channel. In particular, for the datalink in which channel resource is relatively limited such as IEEE 1394, it becomes possible to share the same channel among the network layer multicast packets to be transmitted in a form of reserving bandwidth and multicast packets to be transmitted in a form of not reserving bandwidth, so that the efficient utilization of communication resource can be realized.

Other features and advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram showing an exemplary overall configuration of a communication network according to the firs t embodiment of the present invention.

FIG. **2** is a diagram showing an exemplary correspondence between IP addresses and datalink layer addresses (ATM addresses) on an IP subnet Na side in the communication network of FIG. **1**.

FIG. **3** is a diagram showing an exemplary correspondence between IP addresses and datalink layer addresses (ATM addresses) on an IP subnet Nb side in the communication network of FIG. **1**.

FIG. **4** is a sequence chart for an operation sequence between a guide server and a video terminal in the communication network of FIG. **1**.

FIG. **5** is a block diagram showing default VCs in an intra-station ATM backbone network in the communication network of FIG. **1**.

FIG. **6** is a block diagram showing an exemplary internal configuration of a cell switch router in the communication network of FIG. **1**.

FIG. **7** is a sequence chart for an address resolution sequence between a cell switch router and a video terminal in the communication network of FIG. **1**.

FIG. **8** is another sequence chart for an address resolution sequence between a cell switch router and a video terminal in the communication network of FIG. **1**.

FIG. **9** is a diagram showing one example of a channel used for exchanging ARP packets in the communication network of FIG. **1**.

FIG. **10** is a block diagram showing an exemplary internal configuration of a NIU (Network Interface Unit) in the communication network of FIG. **1**.

FIG. **11** is a diagram showing one example of a routing table provided in a FANP node in the communication network of FIG. **1**.

FIG. **12** is a flow chart for an ARP processing sequence in the communication network of FIG. **1**.

FIG. **13** is a diagram showing one example of a format for an ARP request packet on a 1394 bus in the communication network of FIG. **1**.

FIG. **14** is a block diagram showing an exemplary internal configuration of a 1394 gateway in the communication network of FIG. **1**.

FIG. **15** is a diagram showing one example of a format for an ARP response packet on a 1394 bus in the communication network of FIG. **1**.

FIG. **16** is a diagram showing one example of a format for an IP packet transmitted on a 1394 bus in the communication network of FIG. **1**.

FIG. 17 is a sequence chart for a sequence of a video transmission from a video server to a video terminal in the communication network of FIG. 1.

FIG. 18 is a further detailed sequence chart for a sequence of a video transmission from a video server to a video terminal in the communication network of FIG. 1.

FIG. 19 is a diagram showing one example of a correspondence table provided in a 1394 switch unit in the 1394 gateway of FIG. 14.

FIG. 20 is a diagram showing one example of a format for a VCID exchange message used in the communication network of FIG. 1.

FIG. 21 is a diagram showing one example of a default data connection (VC) and a dedicated data connection between a video server and a video terminal in the communication network of FIG. 1.

FIG. 22 is a sequence chart for an operation sequence of FANP message exchanges between a guide server and a cell switch router in the communication network of FIG. 1.

FIG. 23 is a diagram showing one example of a format for a flow exchange message used in the operation sequence of FIG. 22.

FIG. 24 is a diagram showing one example of a format for a flow exchange message (offer message) used in the operation sequence of FIG. 22.

FIG. 25 is a diagram showing one example of a format for a flow exchange message (pending message) used in the operation sequence of FIG. 22.

FIG. 26 is a diagram showing one example of a format for a VCID exchange message on a 1394 bus used in the operation sequence of FIG. 22.

FIG. 27 is a diagram showing one example of a format for a VCID exchange message (re-direct message) on a 1394 bus used in the operation sequence of FIG. 22.

FIG. 28 is a diagram showing one example of a datalink connection from a video server to a video terminal in the communication network of FIG. 1.

FIG. 29 is a sequence chart for a datalink connection release sequence in the communication network of FIG. 1.

FIG. 30 is a sequence chart for an operation sequence in a case of maintaining and releasing a datalink connection in a soft state in the communication network of FIG. 1.

FIG. 31 is a diagram for explaining a manner of using a flow ID in a case of merging information data flows from two or more sources into an identical datalink connection in the communication network of FIG. 1.

FIG. 32 is a sequence chart for an operation sequence in a case of carrying out a bandwidth reservation control between a cell switch router and a video terminal by using an extended FANP in the communication network of FIG. 1.

FIG. 33 is a block diagram showing an exemplary overall configuration of a communication network according to the second embodiment of the present invention.

FIG. 34 is a block diagram showing an exemplary internal configuration of a half gateway in the communication network of FIG. 33.

FIG. 35 is a diagram showing one example of a correspondence table (for a case of transmitting data received from a 1394 side to an Ethernet side) provided in a 1394/Ethernet transfer unit in the half gateway of FIG. 34.

FIG. 36 is a diagram showing one example of a correspondence table (for a case of transmitting data received from an Ethernet side to a 1394 side) provided in a 1394/Ethernet transfer unit in the half gateway of FIG. 34.

FIG. 37 is a sequence chart for an ARP sequence in the communication network of FIG. 33.

FIG. 38 is a sequence chart for an operation sequence up to a video transmission in the communication network of FIG. 33.

FIG. 39 is a diagram showing one example of a video transmission route from a transmitting terminal to a receiving terminal in the communication network of FIG. 33.

FIG. 40 is a diagram showing one example of a physical shape of a 1394 inter-connection cable, in a case of using an Ethernet cable as a cable for connecting two half gateways.

FIG. 41 is a diagram showing another example of a physical shape of a 1394 inter-connection cable, in a case of connecting two half gateways by radio transmission path.

FIG. 42 is a block diagram showing an exemplary configuration of a home network with a transmitting terminal having a function for receiving MPEG video from a digital satellite broadcast (or digital CATV).

FIG. 43 is a block diagram showing an exemplary internal configuration of a transmitting terminal in the home network of FIG. 42.

FIG. 44 is a block diagram showing another exemplary internal configuration of a transmitting terminal in the home network of FIG. 42.

FIG. 45 is a block diagram showing an exemplary overall configuration of a communication network according to the third embodiment of the present invention.

FIG. 46 is a block diagram showing an exemplary internal configuration of a FANP node in the communication network of FIG. 45.

FIG. 47 is a sequence chart for an ARP sequence in the communication network of FIG. 45.

FIG. 48 is a sequence chart for an operation sequence up to a video transmission in the communication network of FIG. 45.

FIG. 49 is a diagram showing one example of a video transmission route from a transmitting terminal to a receiving terminal in the communication network of FIG. 45.

FIG. 50 is a diagram showing still another example of a physical shape of a 1394 inter-connection cable, in a case of using a relatively short dedicated 1394 cable and a long Ethernet cable.

FIG. 51 is a block diagram showing an exemplary overall configuration of a communication network according to the fourth embodiment of the present invention, in a case of connecting two half gateways through an ATM communication path.

FIG. 52 is a block diagram showing an exemplary internal configuration of a half gateway in the communication network of FIG. 51.

FIG. 53 is a block diagram showing another exemplary overall configuration of a communication network according to the fourth embodiment of the present invention, in a case of connecting two half gateways through a FANP-ATM switch.

FIG. 54 is a block diagram showing an exemplary internal configuration of a FANP-ATM switch in the communication network of FIG. 53.

FIG. 55 is a block diagram showing an exemplary overall configuration of a communication network according to the fifth embodiment of the present invention.

FIG. 56 is a block diagram showing an exemplary internal configuration of a third gateway in the communication network of FIG. 55.

FIG. 57 is a sequence chart for an operation sequence from an ARP up to a video transmission in the communication network of FIG. 55.

FIG. 58 is a block diagram showing an exemplary overall configuration of a network system according to the sixth embodiment of the present invention.

FIG. 59 is a sequence chart for a processing in the system of FIG. 58 in a case of video transfer from a video server to a terminal.

FIG. 60 is a flow chart for the operation by a terminal in the system of FIG. 58 during the processing of FIG. 59.

FIG. 61 is a flow chart for the operation by a connection device in the system of FIG. 58 during the processing of FIG. 59.

FIG. 62 is a diagram showing an exemplary correspondence table stored by the connection device in the system of FIG. 58.

FIG. 63 is a diagram showing an exemplary format of a PATH message of RSVP that can be used in the system of FIG. 58.

FIG. 64 is a diagram showing an exemplary description in a PCR register of IEEE 1394 that can be used in the system of FIG. 58.

FIG. 65 is a sequence chart for a processing in the system of FIG. 58 in a case of video transfer from a video server to a terminal by reserving communication resource on IEEE 1394 from a downstream node of RSVP.

FIG. 66 is a diagram showing a case of transferring different contents by seceding from the already subscribed IP multicast address and subscribing for a different IP multicast address in the system of FIG. 58.

FIG. 67 is a diagram showing a case of changing contents while using the same IP multicast address in the system of FIG. 58.

FIG. 68 is a block diagram showing an exemplary overall configuration of a network system according to the seventh embodiment of the present invention.

FIG. 69 is a sequence chart for a processing in a case where a terminal subscribes for IP multicast in the system of FIG. 68.

FIG. 70 is a flow chart of the operation by an IGMP router in the system of FIG. 69 in a case of subscription for IP multicast address.

FIG. 71 is a diagram showing an exemplary format of a layer-3 flow register used in the system of FIG. 68.

FIG. 72 is a flow chart for the operation by an IGMP router in the system of FIG. 69 in a case of secession from IP multicast address.

FIG. 73 is a sequence chart for a processing of reserving bandwidth for asynchronous stream reserved for IP multicast in the system of FIG. 68.

FIG. 74 is a sequence chart for a processing of notifying a correspondence between IP multicast flow and channel number by using FANP in the system of FIG. 68.

FIG. 75 is a diagram showing an exemplary format of a FANP OFFER message that can be used in the system of FIG. 68.

FIG. 76 is a sequence chart for a processing in a case of transmitting a plurality of flows by using the same IP multicast address in the system of FIG. 68.

FIG. 77 is a flow chart for the operation of an IGMP router in the system of FIG. 68 in a case of transmitting IP multicast data with amount of bandwidth greater than that reserved in advance for isochronous channel.

FIG. 78 is a block diagram of an exemplary configuration for realizing the operation of FIG. 77 in the system of FIG. 68.

FIG. 79 is a sequence chart for a processing in a case of reserving bandwidth for asynchronous stream reserved for IP multicast and using different channel number for isochronous channel with reserved bandwidth in the system of FIG. 68.

FIG. 80 is a sequence chart for a processing in a case of transmission from a plurality of senders with respect to the same IP multicast address in the system of FIG. 68.

FIGS. 81A and 81B are diagrams showing exemplary configuration of IP multicast data transmitted from terminals A and B in the system of FIG. 68 during the processing of FIG. 80.

FIG. 82 is a sequence chart for a processing in a case of transmission from a plurality of senders with respect to the same IP multicast address and using bandwidth reservation in the system of FIG. 68.

FIG. 83 is a sequence chart for a processing in a case of transmission from a plurality of senders with respect to the same IP multicast address and using bandwidth reservation and different channel numbers for isochronous channel and asynchronous stream in the system of FIG. 68.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

First Embodiment

Referring now to FIG. 1 to FIG. 32, the first embodiment of the present invention will be described in detail.

FIG. 1 shows an exemplary configuration of a communication network system according to this first embodiment, which is formed by a CATV network and a home network connected thereto, for example.

As shown in FIG. 1, the communication network system of this first embodiment comprises a video server **101**, a program guide delivery server (referred hereafter as a guide server) **102**, an intra-station ATM backbone network **110**, a cell switch router (CSR) **103**, an access ATM network **111**, an NIU (network Interface Unit) **104**, a first IEEE 1394 bus **112**, a 1394 gateway **105**, a second IEEE 1394 bus **113**, and a video terminal **106**. The whole system (or at least a part of a group of devices constituting this system) is assumed to be subscribed to the Internet.

The video server **101**, the guide server **102**, the intra-station ATM backbone network **110** and the cell switch router **103** are the CATV head-end equipments, and located inside the CATV station. They are assumed to be belonging to an IP (Internet Protocol) subnet Na.

The video server **101** receives a control from the guide server **102**, and delivers a specified video with respect to a specified address. Here, the specified address may be given by the IP address.

The guide server **102** delivers the Web-based (i.e., HTTP-based) program guide through the Internet. The guide server **102** also has a function to notify the content, the attributes, the delivery destination, etc., of a requested program to the video server **101** and control the video server **101**. The guide server **102** also has a function for authenticating and charging users.

The intra-station ATM backbone network **110** is an ATM network constituting the backbone inside the CATV station.

The cell switch router **103** is a device as disclosed in Japanese Patent Application No. 7-58196 (1995), and con-

tains an IP processing unit and an ATM switch therein. By using the FANP (Flow Attribute Notification Protocol) to be described below, the cell switch router **103** is operated by carrying out the protocol exchanges between neighboring FANP nodes (nodes that can carry out the FANP processing). More specifically, the datalink layer connection information (VPI/VCI of ATM, etc.) with a starting point (ending point) at this cell switch router **103** is exchanged between the neighboring FANP nodes, and both connections are coupled by the ATM switch inside this cell switch router **103** so as to realize the ATM switching.

Note that, in the present invention, functions of the FANP are upgraded and modified from those disclosed in Japanese Patent Application No. 7-58196 (1995), so that the FANP used in the present invention will be considered as having a version number [2] in contrast to the FANP used in Japanese Patent Application NO. 7-58196 (1995) which is considered as having a version number [1], in a sense that the former is the upgraded version of the latter.

The access ATM network **111** connects the CATV station with the home. More specifically, it suffices for this part to use the ATM as the datalink scheme, and the subscriber line form can be any suitable form such as FTTH (Fiber To The Home), HFC (Hybrid Fiber Coax), coaxial cable, ADSL (Asymmetric Digital Subscriber Line), etc.

The NIU **104**, two 1394 buses **112** and **113**, the 1394 gateway **105** and the video terminal **106** are devices or networks provided inside the home.

The NIU **104** has a function to terminate the access ATM network **111** and a function to make an inter-connection with the home network. As described below, this node is also the FANP node.

Two 1394 buses **112** and **113** are home networks formed by high speed buses called IEEE 1394. In FIG. **1**, the first 1394 bus **112** is connected only with the NIU **104** and the 1394 gateway **105** while the second 1394 bus **113** is connected only with the 1394 gateway **105** and the video terminal **106**, but in practice, these 1394 buses may also be connected with various other digital devices such as PC, printer, DVD, etc.

The 1394 gateway **105** is a device having a function to connect two (or more) 1394 buses together. Also, the 1394 gateway **105** in this first embodiment is the FANP node as will be described below.

The video terminal **106** is a terminal having a video reception function and an IP processing function.

Here, it is assumed that the cell switch router **103** and the group of devices or networks within the home are belonging to one IP subnet. Namely, it is assumed that one (or more) IP subnet is assigned to each home. In this first embodiment, it is assumed that this IP subnet is assigned with the subnet address Nb.

Also, as shown in FIG. **1**, it is assumed that the IP address of the video server is Na. **1**, the IP address of the guide server **102** is Na. **2**, the IP address of the intra-station ATM backbone network **110** side interface of the cell switch router **103** is Na. **3**, and the IP address of the access ATM network **111** side interface of the cell switch router **103** is Nb. **4**. Also, it is assumed that the IP address of the NIU **104** is Nb. **3**, the IP address of the 1394 gateway **105** is Nb. **2**, and the IP address of the video terminal **106** is Nb. **1**. Here, each of the NIU **104** and the 1394 gateway **105** can have only one IP address even though more than one network interfaces are provided therein.

FIG. **2** shows a correspondence between the addresses on the IP subnet Na side, that is, the IP addresses within the intra-station ATM backbone network **110**, and the datalink layer addresses (ATM addresses). Here, it is assumed that the ATM address prefix of the intra-station ATM backbone network **110** is Aa.

Similarly, FIG. **3** shows a correspondence of the addresses on the IP subnet Nb side.

Here, it is assumed that the ATM address prefix of the access ATM network **111** is Ab, the bus ID of the first 1394 bus **112** is Bb, and the bus ID of the second 1394 bus **113** is Ba.

A terminal connected to each 1394 bus has two 1394 addresses. One is the address called EUI**64** whose value remains unchanged by the bus reset, and the other is the node ID whose value may be changed by the bus reset. Here, the node ID is expressed by an expression format of (Bus ID, Physical ID).

Next, the operation of the entire system of FIG. **1** in a case of video transmission will be described with reference to the flow chart of FIG. **4**.

First, the video terminal **106** receives the program guide transmitted from the guide server **102**.

This program guide is produced by the HTML (HyperText Markup Language) and its transmission protocol is the HTTP (HyperText Transfer Protocol), for example. Namely, the video terminal **106** is in a form of the Web terminal (browser), and the program guide itself is transmitted through the IP (Internet Protocol).

Here, the mechanism by which a general IP packet is transmitted will be described for each part of the entire system. Note that, the general IP packet is an IP packet for which the best-effort transmission is to be carried out, which is not belonging to a specific flow (that is, a set of a series of mutually significant IP packets such as a specific video stream) specified by a user or a device.

As shown in FIG. **5**, a VC (Virtual Connection) **501** for IP packet transmission is set up in advance between the guide server **102** and the cell switch router **103**. Also, the similar VC **502** is set up in advance between the video server **101** and the cell switch router **103**, and the similar VC **503** is set up in advance between the video server **101** and the guide server **102**. When there is no specific specification (by the FANP), these VCs are VCs set up by the default function for the purpose of transferring IP packets therethrough. These VCs will be referred hereafter as the default VCs.

The default VC may be a VC which is established by the ATM-ARP (ATM-Address Resolution Protocol) inside the intra-station ATM backbone network **110**. This will now be described.

At a time of transmitting the IP packet (program guide packet) toward the video terminal **106**, the guide server **102** applies the ATM-ARP inside the intra-station ATM backbone network **110**. Note that the ATM-ARP server is not shown in the figures.

Assuming that the IP address of the video terminal **106** is Nb. **1**, this video terminal **106** belongs to the IP subnet Nb rather than the IP subnet Na inside the CATV station, so that this resolution address (ATM address) is going to be the address of a router pointing toward the IP subnet Nb, that is, the address (ATM address) of the cell switch router **103**.

When it is detected that the ATM connection pointing toward the resolution ATM address is already set up (VC **501**), the guide server **102** transmits that IP packet through this VC **501**.

The cell switch router **103** receives this IP packet through the default VC **501**.

FIG. **6** shows an exemplary internal configuration of the cell switch router **103**. As shown in FIG. **6**, the cell switch router **103** comprises an IP/FANP processing and switch control unit **601** and an ATM switch unit **602**.

The IP/FANP processing and switch control unit **601** has a function for processing the received IP packet or FANP packet, and a function for controlling the setting of the ATM switch unit **602** according to the FANP processing result. Note that, among the VCs from the connected ATM network, for each of the VCs **501** and **502** which is the default VC set up from the beginning for the purpose of IP packet transfer, a VC terminal point is always the IP/FANP processing and switch control unit **601** inside this cell switch router **103**.

The ATM switch unit **602** comprises an ATM switch. Among output ports of the ATM switch, at least one is set at the IP/FANP processing and switch control unit **601**.

Here, the setting is made so that the IP packet transmitted through the default VC will be always forwarded to the IP processing unit (IP/FANP processing and switch control unit **601**) of the nodes at two ends of that default VC.

When it is confirmed that the received IP packet is destined to the video terminal **106** (by confirming that the destination IP address of this IP packet is the IP address Nb. **1** of the video terminal **106**), the IP processing unit (IP/FANP processing and switch control unit **601**) of the cell switch router **103** carries out the routing according to the internal IP routing table so as to determine the output physical port.

At the output physical port, the cell switch router **103** carries out the ATM-ARP with respect to the access ATM network **111** so as to determine the VC for transmitting this IP packet. Note that, in FIG. **1**, the ATM-ARP server to be used here is also not shown.

The ATM-ARP is carried out with respect to the entire access ATM network **111**, and eventually the ATM address of the NIU **104** will be resolved.

The ATM address to be resolved here is that of the NIU **104** and not that of the video terminal **106**. Namely, this address resolution is the proxy resolution, that is, the deputy resolution. In a case where the ATM network and the other network (such as the Ethernet or the 1394 bus **112** or **113** of this embodiment) are inter-connected, the address to be resolved in response to the address resolution request from inside the ATM network should be an ATM address, but a resolution target terminal may not necessarily be present on the ATM network, so that the ATM address of the NIU **104** will be resolved in this case.

In the system of this embodiment, as will be described below, the cell switch router **103**, the NIU **104** and the 1394 gateway **105** are the FANP nodes, so that the ARP is terminated once at each of these nodes and the responded by proxy. Namely, the address resolution is carries out sequentially in time series as shown in FIG. **7**. (Step **S701**): The address resolution request for the address of the video terminal **106**, from the cell switch router **103** to the access ATM network **111**.

(Step **S702**): The address resolution request for the address of the video terminal **106**, from the NIU **104** that received the address resolution request of the step **S701** to the first 1394 bus **112**.

(Step **S703**): The address resolution request for the address of the video terminal **106**, from the 1394 gateway **105** that received the address resolution request of the step **S702** to the second 1394 bus **113**.

(Step **S704**): The address resolution from the video terminal **106** to the 1394 gateway **105** (where the resolved address is the 1394 address of the video terminal **106**).

(Step **S705**): The address resolution from the 1394 gateway **105** to the NIU **104** (where the resolved address is the 1394 address of the 1394 gateway **105**). (Step **S706**): The address resolution from the NIU **104** to the cell switch router **103** (where the resolved address is the ATM address of the NIU **104**).

When the above procedure is finished, the IP packet transmission sequence is carried out (steps **S707**, **S708** and **S709**).

The procedure shown in FIG. **7** is a scheme in which the address resolution is carried out sequentially from an end, and the IP packet transmission is started at a timing where all the datalink layer addresses are resolved. However, it is also possible to use a scheme as shown in FIG. **8** in which the address resolution is carried out hop by hop, and the IP packet is forwarded sequentially every time the address is resolved.

Now, according to the resolved ATM address (the ATM address of the NIU **104**), the cell switch router **103** checks whether there is an ATM-VC (a default VC **901**) that is established with respect to this ATM address or not. Here, if it is not established yet, it is established, as indicated in FIG. **9**.

Thereafter, the cell switch router **103** transmits the IP packet through the VC **901**, and this IP packet reaches to the NIU **104**.

FIG. **10** shows an exemplary internal configuration of the NIU **104**. As shown in FIG. **10**, the NIU **104** comprises an ATM physical layer processing unit **1001**, an ATM/AAL processing unit **1002**, a first MUX/DEMUX **1003**, an IP/FANP processing unit **1004**, a second MUX/DEMUX **1005**, a 1394 link processing unit **1006**, a 1394 physical processing unit **1007**, an ATM/1394 transfer unit **1008**, an ATM control unit **1009**, and a 1394 control unit **1010**.

The ATM physical layer processing unit **1001** has a function for terminating the ATM transmission path from the external, carrying out the ATM physical layer processing, and forwarding the ATM cell to the neighboring ATM/AAL processing unit **1002**, and a function for applying the ATM physical layer processing with respect to the ATM cell flow from the ATM/AAL processing unit **1002** and transmits it to the external.

The ATM/AAL processing unit **1002** applies the ATM layer processing and the AAL processing to the ATM cell flow received from the ATM physical layer processing unit **1001**, takes out the AAL-SDU (AAL Service Data Unit: IP packet, MPEG frame, etc.), and transmits it to the IP/FANP processing unit **1004**, the ATM/1394 transfer unit **1008**, or the ATM control unit **1009** (in a case of the signaling packet, etc.) through the first MUX/DEMUX **1003**, by referring to the VCI value, according to the mechanism to be described below. Also, the ATM/AAL processing unit **1002** has a function for assembling ATM cells by applying the AAL (ATM Adaptation Layer) processing to data (IP packet, MPEG frame, etc.) from the first MUX/DEMUX **1003** and assembling ATM cells, and transmitting them to the neighboring ATM physical layer processing unit **1001** by applying the ATM layer processing.

The first MUX/DEMUX **1003** has a function for distributing data from the ATM/AAL processing unit **1002** into the IP/FANP processing unit **1004**, the ATM/1394 transfer unit **1008**, and the ATM control unit **1009**, according to the VCI value, and a function for collecting data from the IP/FANP

processing unit **1004**, the ATM/1394 transfer unit **1008**, and the ATM control unit **1009** into the ATM/AAL processing unit **1002**.

The IP/FANP processing unit **1004** has a function for terminating the IP packets or the FANP packets transmitted from the ATM side or the 1394 side, and applying the IP processing and the FANP processing. Hence, the IP packets (including the FANP packets) transmitted through the default VCs (the asynchronous channels or asynchronous writes for the 1394 side as described below) from the ATM side and the 1394 side will be forwarded to this IP/FANP processing unit **1004**. The IP/FANP processing unit **1004** also has a function for carrying out a series of ARP procedures such as the address resolution from the IP address to the datalink address (the ATM address, the 1394 address).

At this IP/FANP processing unit **1004**, the packet routing processing (a processing for determining the physical port to which the IP packet is to be transmitted) is carried out according to the destination IP address of the IP header, but unlike the general router, the so called IP routing protocol processing is not carried out at this part.

The second MUX/DEMUX **1005** has a function for collecting data from the IP/FANP processing unit **1004** and the ATM/1394 transfer unit **1008** into the neighboring 1394 link processing unit **1006**, and a function for distributing data from the 1394 link processing unit **1006** into the IP/FANP processing unit **1004** and the ATM/1394 transfer unit **1008**, by referring to the channel number, etc.

The 1394 link processing unit **1006** and the 1394 physical processing unit **1007** carry out the link layer processing and the physical layer processing of the IEEE 1394, respectively. Namely, they provide a function for receiving data from the second MUX/DEMUX **1005** at the 1394 link processing unit **1006**, forming 1394 frames from it, and transmitting them to the 1394 link, in cooperation with the 1394 control unit **1010** described below, and a function for applying the respective 1394 layer processings to 1394 frames (containing both isochronous ones and asynchronous ones) from the 1394 link in cooperation with the 1394 control unit **1010**, and transmitting them to the second MUX/DEMUX **1005**.

The ATM/1394 transfer unit **1008** has a function for setting data from the ATM side and the 1394 side into conformity with the respective formats, carrying out the datalink conversion, and forwarding them. The data that pass through here are going to flow between the ATM side and the 1394 side without passing through the IP/FANP processing unit **1004** described above. Hence, the data forwarding without the IP/FANP processing by the IP/FANP processing unit **1004** can be realized directly through this ATM/1394 transfer unit **1008**, according to the VPI/VCI of the ATM or the channel number or the destination address of the specific register offset of the 1394, regardless of the type of information such as IP packet, MPEG frame, etc., so that a considerable simplification of processing and improvement of processing time can be expected. It also becomes possible to reduce the processing of the IP/FANP processing unit **1004**. Here, the register offset is a region that can be allocated node by node, which is given by the last 48 bits address space of the IEEE 1394 address mapping.

The ATM control unit **1009** carries out the control of the ATM related part, the signaling processing, etc.

The 1394 control unit **1010** mainly carries out the IEEE 1394 transaction layer processing and the serial bus management. The 1394 control unit **1010** has a function for carrying out data exchange with the 1394 link processing unit **1006** by applying the above processing, for the necessary data to/from the IP/FANP processing unit **1004**.

Now, the procedure according to FIG. **7** will be described.

The setting is made in advance at the NIU **104** so that, among data entered from the default VC (**901** of FIG. **9**) established by the ATM side, the received IP packets will be forwarded to the IP/FANP processing unit **1004** provided therein.

At first, the NIU **104** (actually not only the NIU **104** but also the FANP nodes such as the 1394 gateway **105**) has a routing table as shown in FIG. **11** therein, by which an information as to which IP terminal exists at the physical port of which direction is provided. This is realized in a form of providing a routing table at a time of carrying out the source routing for each IP terminal (i.e., an entry is registered in the routing table for each IP address one by one). It is also possible to realize it similarly as the learning bridge so that whenever an IP address which is not yet registered in the routing table is detected, such an IP address is registered into the routing table sequentially. It is also possible to realize it such that an IP address for which the passing of a IP packet cannot be detected for a certain period of time will be deleted from the routing table.

Now, the processing procedure at the step **S701** of FIG. **7** will be described.

As shown in FIG. **12**, at the IP/FANP processing unit **1004** of the NIU **104**, when it is confirmed that the received packet is the ARP request (step **S1201**), that the ARP requested IP address is not the own IP address (step **S1202**), and that this IP address is not registered in the routing table provided therein (step **S1203**), this ARP request is forwarded to the other physical port provided therein, such as the physical port of the first 1394 bus (network) **112** of FIG. **1** in this embodiment, for example. At this point, the own (NIU **104**'s) 1394 address is written into the source address of the ARP request packet to be transmitted.

FIG. **13** shows one exemplary frame/packet format for the ARP request to be transmitted from the NIU **104** to the first 1394 bus **112**. In this way, the ARP request is transmitted to the asynchronous channel, i.e., **902** of FIG. **9**, in a form of having the ARP packet encapsulated within the 1394 frame.

This ARP request is transmitted to be broadcasted to the first 1394 bus **112**, so that it is transmitted with the destination ID of the 1394 frame in a form of "bus ID=local bus, physical ID=broadcast" or "bus ID=ID of the bus it belongs to, physical ID=broadcast" or "channel number=assigned asynchronous stream channel". The own node ID is entered into the source ID. Note that, in a case where the 1394 buses are inter-connected through the 1394 bridge which is expected to be standardized in future at the IEEE, it is also possible to consider a method for activating the ARP by using the destination ID in a form of "broadcast bus ID" by which it is transmitted toward all the 1394 buses, instead of using the method here, within the 1394 part. In this case, the destination 1394 address is directly resolved so that the reservation of the isochronous channel up to the destination terminal may be made by the internal protocol (such as IEC 61663, for example) of the 1394.

Returning to the description of FIG. **13**, in the 1394 data portion, the ARP packet is entered into a region following the LLC/SNAP region. For the ARP packet to be encapsulated, an IEEE 1394 number is entered as the hardware type, an IP is entered as the protocol type, and the length indication and the fact that this packet is the ARP request are described in the ARP header. In addition, in the data portion, it is also possible to describe the own two 1394 addresses, that is, an ID called EUI**64** which is unchanged by the bus reset (which is the ID to be imprinted at a time of

shipment by the hardware vender) and an address in the 1394 address space at that point (a node ID and a memory/register address). For example, in a case of the NIU **104**, EUI**64** will be E**4**, and the node ID will be (Bb, **2**).

Moreover, the own (NIU **104**'s) IP address is also described. Here, a dummy value is entered for the unresolved destination 1394 address, so that only the destination IP address (resolution requested IP address Nb. **1**) is entered.

The 1394 frame as shown in FIG. **13** is transmitted to the first 1394 bus **112** through the asynchronous channel. This frame will be received by all the nodes which are connected to the first 1394 bus **112**. Among them, a terminal which cannot understand the LLC/SNAP as well as a terminal which does not have the IP processing function and the FANP processing function will discard this frame immediately. Even at a terminal which has the IP processing function, if this terminal does not have the router function or the FANP function and the own IP address is not the resolution requested IP address of the ARP, this frame will be ignored.

At the first 1394 bus **112**, there is no IP terminal which has the IP address (Nb. **1**), while the 1394 gateway **105** has the FANP function.

FIG. **14** shows an exemplary internal configuration of the 1394 gateway **105**. As shown in FIG. **14**, the 1394 gateway **105** comprises a first 1394 physical processing unit **1401**, a first 1394 link processing unit **1402**, a first MUX/DEMUX **1403**, an IP/FANP processing unit **1404**, a second MUX/DEMUX **1405**, a second 1394 link processing unit **1406**, a second 1394 physical processing unit **1407**, a 1394 switch unit **1408**, a first 1394 control unit **1409**, and a second 1394 control unit **1410**.

The first 1394 physical processing unit **1401**, the first 1394 link processing unit **1402**, and the first 1394 control unit **1409** provide the physical layer, link layer, and the transaction layer/serial bus management functions of the IEEE 1394 on the first 1394 bus **112** side, so as to carry out the data forwarding from the isochronous channel to the asynchronous channel with respect to the IP/FANP processing unit **1404** or the 1394 switch unit 1394 bidirectionally, according to the channel number of the 1394 or the destination ID or the destination ID with the specific register offset, through the first MUX/DEMUX **1403**.

The second 1394 physical processing unit **1407**, the second 1394 link processing unit **1406**, and the second 1394 control unit **1410** also provide the similar functions on the second 1394 bus **113** side.

The IP/FANP processing unit **1404** has the same functions as the IP/FANP processing unit **1004** in the NIU **104** of FIG. **10** as described above.

The 1394 switch unit **1408** is a device for carrying out data exchange directly among plural 1394 ports, without using the processing at the IP/FANP processing unit **1404**, between the first MUX/DEMUX **1403** and the second MUX/DEMUX **1405**. This 1394 switch unit **1408** plays a role of buffer in a case of transferring from one 1394 bus to another 1394 bus. Also, whenever necessary, this 1394 switch unit **1408** carries out the processing like the re-stamping of the timestamp of the MPEG stream, for example. In such a case, there is provided a correspondence table as shown in FIG. **19** for directly indicating a correspondence of the channel number or the destination address with the specific register offset of the 1394 bus on one side with the attribute, the destination physical port, and the channel number after conversion, etc.

Next, the processing procedure of the step S**702** of FIG. **7** will be described.

Here, the setting is also made in advance at the 1394 gateway **105** so that, the IP packet arrived at the 1394 gateway **105** will be forwarded to the IP/FANP processing unit **1404** provided therein, after receiving the LLC/SNAP analysis.

Similarly as in FIG. **12**, at the IP/FANP processing unit **1404** of the 1394 gateway **105**, when it is confirmed that the received packet is the ARP request, that the ARP requested IP address is not the own IP address, and that this IP address is not registered in the routing table provided therein (steps S**1201** to S**1203**), this ARP request is forwarded to the other physical port provided therein, such as the physical port of the second 1394 bus **113** in this embodiment. At this point, the own (1394 gateway **105**'s) 1394 address E**2**/(Ba, **2**) on the second 1394 bus **113** side is written into the source address of the ARP request packet to be transmitted.

This ARP request is also broadcasted on the second 1394 bus **113**. The video terminal **106** which received this ARP request recognizes that it is the ARP request destined to itself, and returns the ARP response (step S**704** of FIG. **7**).

At this point, as shown in FIG. **15**, the ARP response packet is generated by interchanging the source address and the destination address within the ARP packet and entering the own IP address (Nb. **1**) and 1394 address (E**1**/Ba, **1**). Then, the 1394 frame is generated by setting the destination address of (Ba, **2**), i.e., that of the 1394 gateway **105**, and this 1394 frame is transmitted to the asynchronous channel or asynchronous write (**903** of FIG. **9**) of the second 1394 bus **113**.

When this 1394 frame is received, the 1394 gateway **105** registers that the IP terminal Nb. **1** exists on the second 1394 bus **113** side into the internal routing table, and registers the IP address (Nb. **1**) of the video terminal **106** as well as the table of correspondence with the 1394 address as shown in FIG. **11** into the internal ARP table (steps S**1205** to S**1206** of FIG. **12**). Here, the ARP table and the routing table may be formed integrally, and FIG. **11** shows the integrally formed one.

The 1394 gateway **105** has already recognized that the ARP request with respect to the video terminal **106** has come from the NIU **104** of the first 1394 bus **112** side, so that the 1394 gateway **105** continues to return the ARP response to it (step S**705** of FIG. **7** and step S**1207** of FIG. **12**). At this point, the response 1394 address is answered as the 1394 address (E**3**/Bb, **1**) of the 1394 gateway **105**. In other words, this is also the deputy response.

Similarly, the NIU **104** also transmits the deputy response for the ARP (in which the NIU **104**'s own ATM address Ab. **1** is described as the resolved ATM address) to the cell switch router **103** through the access ATM network **111** (steps S**706** of FIG. **7** and step S**1207** of FIG. **12**). At this point, the VC **901** is used.

At this point, at the 1394 gateway **105**, the fact that the IP address (Nb. **1**) of the video terminal **106** exists on the second 1394 bus **113** side is registered in the internal routing table, and its 1394 address (the 1394 address (E**1**/Ba, **1**) of the video terminal **106**) is registered in the internal ARP table. Also, at a time of the ARP request packet processing, the IP address Nb. **3** of the NIU **104** and its 1394 address (E**4**/Bb, **2**) are also registered in the routing table and the ARP table, respectively on the first 1394 bus **112** side (see FIG. **3**).

Also, at the NIU **104**, the fact that the IP address (Nb. **1**) of the video terminal **106** exists on the first 1394 bus **112** side

is registered in the internal routing table, and as its 1394 address, the 1394 address of the 1394 gateway **105** (the 1394 address (E3/Bb, **1**) on the first 1394 bus **112** side) is registered in the internal ARP table because of the deputy response. Also, at a time of the ARP request packet processing, the IP address Nb. **4** of the cell switch router **103** and its ATM address are registered in the routing table and the ARP table respectively, on the access ATM network **111** side (see FIG. **3**).

Also, at the cell switch router **103**, the fact that the IP address (Nb. **1**) of the video terminal **106** exists on the access ATM network **111** side is registered in the internal routing table, and as its ATM address, the ATM address Ab. **1** of the NIU **104** is registered in the internal ARP table because of the deputy response (see FIG. **3**). At this point, it becomes possible for the cell switch router **103** to transmit the IP packet destined to the video terminal **106**. Namely, the cell switch router **103** transmits this IP packet through the default VC **901** (which will be established if not already established at this point) that is established between the NIU **104** and the cell switch router **103**.

The default VC is established to be connected to the IP/FANP processing unit **1004** of the NIU **104**.

When this IP packet reaches to the NIU **104**, it is conveyed to the IP/FANP processing unit **1004**. Here, the IP/FANP processing unit **1004** recognizes that the destination IP address of Nb. **1** exists on the first 1394 bus **112** side by referring to the routing table, and recognizes its 1394 address (actually the 1394 address Bb. **1** of the 1394 gateway **105**) by referring to the internal ARP table, so that the IP/FANP processing unit **1004** encapsulates this IP packet within the 1394 frame destined to the 1394 gateway **105** and transmits this 1394 frame to the first 1394 bus **112** through the asynchronous channel.

FIG. **16** shows a format of the IP packet transmitted on the 1394 bus. As shown in FIG. **16**, the IP packet is basically transmitted to the asynchronous write of the 1394, and encapsulated within the asynchronous frame of the 1394.

Because of the setting made in advance according to which the IP packets and FANP packets that arrive at the 1394 gateway **105** through the-asynchronous channel or asynchronous write of the 1394 are to be connected to the IP/FANP processing unit **1404** upon referring to the LLC/SNAP header, when this IP packet arrives at the 1394 gateway **105**, it is conveyed to the IP/FANP processing unit **1404**. Here, the IP/FANP processing unit **1404** recognizes that the destination IP address of Nb. **1** exists on the second 1394 bus **113** side by referring to the routing table, and recognizes its 1394 address (Ba, **1**) by referring to the internal ARP table, so that the IP/FANP processing unit **1404** encapsulates this IP packet within the 1394 frame destined to the video terminal **106** and transmits this 1394 frame to the second 1394 bus **113** through the asynchronous channel.

In this manner, the IP packet reaches to the video terminal **106** (steps **S707** to **S709** of FIG. **7** and step **S401** of FIG. **4**).

Thereafter, the packet destined to the video terminal **106** that is transmitted from the guide server **102** can be routed to the video terminal **106** without requiring the ARP procedure.

At the video terminal **106**, the program guide transmitted through these IP packets is displayed through the browser on the video terminal **106**. The user makes the request for a desired program through this browser. This request is also made by using the IP/HTTP (step **S402** of FIG. **4**). Of course, there is no need for the user to be conscious of facts like what communication protocol is being used.

Thereafter, various control procedures are carried out in order to carry out the video service such as the user authentication, the charging procedure, etc., between the guide server **102** and the user (video terminal **106**) (step **S403** of FIG. **4**). These control procedures are also carried out by using IP/HTTP.

When these procedures are finished, the operation proceeds to a procedure for the purpose of video delivery. First, a control signal for program transmission is transmitted from the guide server **102** to the video server **1-1** (step **S404** of FIG. **4**). This control signal exchanges the basic information concerning the video transmission such as which program is transmitted for how long and to whom. This control signal exchange is carried out through the default VC **203** between the guide server **102** and the video server **101**. This operation may be realized through the CGI and the like of the guide server. There is also a case in which the procedure is carried out directly with respect to the video server **1-1** by using the language such as JAVA.

After that, the exchanges for procedures that should be done prior to the video transmission are carried out between the video server **101** and the video terminal **106**. For example, the confirmation of the coding scheme, the confirmation of the reception possible bandwidth value, etc., are carried out (step **S405** of FIG. **4**). These exchanges may be carried out through IP/HTTP similarly as described above. When the agreement between the video server **1-1** and the video terminal **106** is made, the operation proceeds to a procedure for establishing a datalink connection for guaranteeing the bandwidth from the video server toward the video terminal.

Next, this procedure will be described with references to FIG. **17** and FIG. **18**.

Consider a case of deliverying video by a certain bandwidth (4 Mbps, for example) with respect to the video terminal **106** (IP address Nb. **1**). The video server **101** carries out the address resolution for the IP address Nb. **1** (step **S1701**), and then carries out the ATM call set up between the video server **101** and the cell switch router **103** so as to establish an ATM connection having the bandwidth of 4 Mbps between the video server **101** and the cell switch router **103** that corresponds to the resolved address (step **S1702**).

Here, for the detailed parameters required in a case of the call set up, appropriate values are set up in advance at the video server side, and these values are to be utilized as they are.

When the call set up is completed and the ATM connection **2101** of 4 Mbps is established between the video server **101** and the cell switch router **103**, the video server **101** starts the processing determined by the FANP by using this ATM connection **2101**.

The datalink connection established in this manner for the purpose of some specific flow transmission between the FANP nodes will be called a dedicated datalink connection.

The FANP is a protocol for notifying (ID of) the connection with the datalink and a relation with respect to the information to be sent through that connection to the neighboring node. In the following, this procedure will be described in detail. Note that the present invention uses the FANP function which is modified from the conventional FANP function, and such a modified FANP function will be referred to as an extended FANP function hereafter. In the following, the detailed descriptions will be given for such modified portions.

At the step S**1703** of FIG. **17**, first, the video server **101** exchanges the VCID exchange messages through the estab-

lished ATM connection **2102** as shown in FIG. **21**. Through this message exchange, the devices on both ends share the meaning of the VCID value (which will be described below). This operation is carried out through the exchange of the VCID exchange messages of the FANP (see FIG. **22**).

FIG. **20** shows an exemplary format of a message to be exchanged here. This message format is almost the same as the format of the ARP packet in the ATM-LAN. The hardware type is set to be ATM, the protocol type is set to be IP, the sender IP address is set to be the IP address of the video server **101**, the target IP address is set to be the IP address of the video terminal **106**, and the VCID (Virtual Connection ID) is set to be a globally unique address (MAC address of the ATM board) of the video server **101** and a sequence number appropriately determined by the video server **101**.

The VCID is an identifier that can be commonly recognized at both ends of the VC, which is provided because the VPI/VCI is generally different at both ends of the VC in the ATM.

Also, as the VCID exchange messages, ACK and NACK are provided, and they are to be distinguished by the operation code. This ACK/NACK is sent through the default VC **502** as shown in FIG. **22**. Here, when ACK is returned, it implies that the agreement on the VCID value is made between the devices at both ends. When NACK is returned, it implies that no agreement is made.

In a case where the FANP node is a router, the ACK message is returned by simply changing the operation code value. A case where the FANP node is not a router will be described below.

When the agreement on the VCID is made, the video server **1-1** starts the exchange of the flow exchange message next as indicated in FIG. **22**.

In the present invention, the reservation of the dedicated datalink connection is requested to the next hop node through this flow exchange message. Namely, the information on the destination IP address, a desired bandwidth to be reserved, the communication attribute, etc. are attached to this flow exchange message and this flow exchange message is sent to the next hop FANP node, so as to request the next hop FANP node to set up an end-to-end connection connected to the target terminal.

The FANP node reserves the necessary datalink connection (dedicated datalink connection) that satisfies the sequentially requested conditions between the neighboring nodes, and relates this dedicated datalink connection with the dedicated datalink connection notified from the previous hop. This relating operation is carried out on the VCI table. After this relating operation is carried out, values of the reserved bandwidth, the attribute (indicating that data flowing therethrough is the MPEG video, etc.), the output port, the output header (VPI/VCI), etc., can be ascertained implicitly by simply referring to the value of the VPI/VCI.

This operation is carried out sequentially up to the destination terminal (the video terminal **106** in this embodiment), and eventually the end-to-end connection is established.

FIG. **23** shows an exemplary format of the flow exchange message. By the operation code portion of this flow exchange message, the type of the flow exchange message is indicated.

The flow exchange message includes an offer message (operation code=1), a re-direct message (operation code=2), an error message (operation code=3), a release message (operation code=4), a release ACK message (operation code=5), and a pending message (operation code=6). For details, see Japanese Patent Application No. 7-58196 (1995).

In this embodiment, the value "1" is fixedly entered into the VCID type. When the VCID type=1, an ESI (End System ID, which is usually the MAC address of the end system) and a sequence number are entered into the VCID.

This VCID has the meaning that there is an agreement that "let's call this VC (isochronous channel) by the VCID value at the FANP nodes of both ends". (Note that, when a different scheme for expressing the VCID appears, another value will be allocated.)

The flow ID type specifies a scheme for expressing the flow ID. Here, the flow is a specific meaningful information (a specific set of mutually meaningful information transmitted toward a specific destination from a specific source). The flow ID is an ID for uniquely identifying a certain flow. This flow ID will be described in further detail below.

The other parameters are optional, and given by TLV (Type, Length, Variable) based descriptions. In this embodiment, the communication quality information, the end-to-end ACK (e-ACK), and the communication attribute are entered there.

To the communication quality information, a value of communication quality to be required to the connection to be established will be entered. For this value, a T-spec value of int-serv of IETF may be entered, for example. In this embodiment, it suffices to enter a value which indicates 4 Mbps which is a value of the required bandwidth.

The e-ACK flag is a flag for requesting the transmission of an ACK signal from the final point to the transmission point. This end-to-end ACK signal will provide a clue for the transmission device (the video server **101** in this embodiment) to ascertain whether the connection establishing up to the final point (the video terminal **106** in this embodiment) has been successful or not.

The video server **101** sends the offer message among the flow exchange messages to the cell switch router **103** which is the neighboring FANP node, as indicated in FIG. **22**. This message sending is carried out through the default VC **502** between the video server **101** and the cell switch router **103**.

This message contains the operation code indicating that it is the offer message, the VCID, the flow ID, the communication attribute, the communication quality (bandwidth information), and the e-ACK flag, as indicated in FIG. **24**. The last three of these are options expressed in the TLV format.

To the VCID, the MAC address of the video server **101** and the sequence number assigned by the video server **101** are entered.

To the flow ID, basically a value such as the destination IP address is entered, as will be described below.

To the communication attribute, an indication that the data to be transmitted is the MPEG stream is entered.

The bandwidth information indicates the bandwidth of that video stream (4 Mbps in this embodiment), and the e-ACK flag is ON because the video server **101** requests the end-to-end ACK.

At the cell switch router **103** which is the neighboring FANP node that received this message, the received packet is processed by the IP/FANP processing and switch control unit **601**.

By looking at the e-ACK flag, it can be understood that the transmitting side requests the reservation of the end-to-end connection. Therefore, in order to establish the end-to-

end connection, the forwarding of the FANP message toward the direction of the destination IP address (the video terminal **106**) and the pending message for the purpose of notifying "please wait for awhile until the connection is established (or the processing load becomes lower)" to the transmitting side (the video server **101**) are defined (see FIG. **25**).

The pending message is transferred after the VCID and the flow ID possessed by the corresponding offer message are attached thereto.

At the video server **101** that received the pending message, a response to the earlier transmitted offer message will be awaited for awhile.

Also, the cell switch router **103** forwards this FANP message toward the direction of the video terminal **106** so as to establish the end-to-end datalink connection, and tries to transmit the offer message toward the direction of the video terminal **106**.

At this point, the resolved address of the video terminal **106** is the ATM address of the NIU **104**, so that the ATM connection with the bandwidth (4 Mbps) described in the offer message is established between the cell switch router **103** and the NIU **104** (step **S1704** of FIG. **17**). Namely, as shown in FIG. **21**, the ATM connection **2102** for video transmission is established in addition to the default VC **901**.

When this ATM connection **2102** is established, the cell switch router **103** transmits the VCID exchange message through the ATM connection **2102** similarly as in a case of the video server **101** (step **S1705** of FIG. **17**). Note that the setting is made in advance so that the data transmitted through this ATM connection **2102** will be transmitted to the IP/FANP processing unit **1004** of the NIU **104**.

At the NIU **104** that received this message, it is ascertained that the destination IP address of the FANP message is not its own, and it is directed to the video terminal **106** (IP address=Nb. **1**), from this VCID exchange message. Assuming that the subsequently arriving FANP message (such as the offer message) is destined to the IP address (Nb. **1**) of the video terminal **106**, the IP/FANP processing unit **1004** of the NIU **104** cannot confirm that this is the FANP packet unless the protocol type and the port number of the IP packet are checked, so that either the FANP processing cannot be carried out or else the protocol type and the port number must be checked for all packets destined to the IP/FANP processing unit **1004** in order to carry out the FANP processing.

In order to avoid this, the fact that the neighboring FANP node is not the video terminal **106** but the NIU **104** is notified to the cell switch router **103** which is the neighboring FANP node. To this end, the own IP address (Nb. **3**) is entered into a field for the target IP address in the VCID exchange message, and the propose ACK message is returned (see FIG. **20**).

In this way, the cell switch router **103** can ascertain that the next hop FANP node is not the video terminal **106** but the NIU **104** (IP address=Nb. **3**) in the routing path toward the video terminal **106**, and recognize that it suffices to transmit the subsequent FANP message (the FANP message toward the video terminal **106**) about that VCID value to the NIU **104**.

After that, the cell switch router **103** transmits the offer message of the flow exchange messages to the NIU **104**. Hence, by the ARP table search, this offer message will be transmitted through the default VC **901**. The destination IP address of this offer message is the IP address Nb. **3** of the NIU **104**.

The NIU **104** can ascertain the final target IP address (the IP address of the video terminal **106**) by looking at the flow ID portion (which will be described below). The others including the communication attribute, the communication quality, the e-ACK flag, etc. are forwarded as they are.

At the NIU **104** that recognized the need to set up a connection of 4 Mbps to the video terminal **106** in this way, the fact that the video terminal **106** exists in the direction of the first 1394 bus **112** is recognized by referring to the internal routing table, and the establishing of an isochronous channel of 4 Mbps on the first 1394 bus **112** is carried out.

This operation is done as the NIU **104** appropriately sets up the isochronous resource manager register, and sequentially carries out the reservation of the bandwidth and the reservation of the channel number (step **S1706** of FIG. **17**).

Next, the NIU **104** carries out the sending of the VCID exchange message (step **S1707** of FIG. **17**), and there are several methods for realizing this operation.

The first method is a method in which the earlier acquired isochronous channel number is notified to the 1394 gateway **105** by the protocol of the 1394 itself, and the setting is made in advance so that this channel will be connected to the IP/FANP processing unit **1404**. Else, the setting may be made such that the established isochronous channel will be connected to the IP/FANP processing unit **1404** by default. It is also possible to make the setting in which the fact that this is the IP/FANP packet is recognized by referring to the LLC/SNAP header, and then this is transferred to the IP/FANP processing unit **1404**.

The FANP node may have the setting by which the IP/FANP processing unit **1404** distinguishes the input packet as either the IP packet or the FANP packet and carries out the FANP processing only if it is the FANP packet.

After that, the VCID exchange message as shown in FIG. **26** is sent to that isochronous channel. At the IP/FANP processing unit **1404** of the 1394 gateway **105** that received this VCID exchange message, the own IP address (Nb. **2**) is entered into the ACK message and this ACK message is returned to the NIU **104** through the asynchronous channel or asynchronous write.

The sequence shown in FIG. **18** shows the sequence shown in FIG. **17** in further detail according to the first method as described above.

The second method is a method for sending the VCID exchange message toward the 1394 gateway **105** by using the asynchronous channel or asynchronous write. The resolved address of the video terminal **106** is set to be the 1394 address of the 1394 gateway **105**. The setting is made such that this VCID exchange message reaches to the IP/FANP processing unit **1404** of the 1394 gateway **105**. One method for realizing the above setting is to make the setting in advance such that the VCID exchange message automatically reaches to the IP/FANP processing unit **1404**. Another method for realizing the above setting is a method in which the NIU **104** carries out the RARP and the like from the 1394 address of the 1394 gateway **105** to check the IP address Nb. **2** of the 1394 gateway **105** in advance, and sends the VCID exchange message toward this IP address Nb. **2**.

The third method is a method for a case in which the setting is made in advance such that the message is conveyed to the IP/FANP processing unit **1404** by the LLC/SNAP. The 1394 gateway **105** that received this message attaches the own IP address to the ACK of the VCID exchange message and returns this ACK to the NIU **104**, similarly as in a case of the NIU **104**. In this way, the NIU **104** can also recognize

that the next hop FANP node leading to the video terminal **106** is the 1394 gateway **105** (IP address=Nb. **2**), so that it becomes possible to send the subsequent FANP packet (flow exchange message) with respect to the 1394 gateway **105**, rather than sending it directly to the video terminal **106**.

The above described is an exemplary case of reserving the isochronous channels, but in a case of using the register offset in the asynchronous mode, an agreement is made on a value of the register offset to be used at a time of communication between the NIU **104** and the 1394 gateway **105**. Thereafter, in the FANP message, this register offset value is transmitted instead of the isochronous channel number.

The operation at the 1394 gateway **105** after that is the similar to the operation at the NIU **104** described above. Namely, the flow exchange message is received, and the need to establish the reservation of the bandwidth of 4 Mbps between the 1394 gateway **105** and the video terminal **106** is recognized. The pending message is sent to the NIU **104** which is the previous hop FANP node, while the isochronous channel of 4 Mbps and its channel number are reserved on the second 1394 bus **113** with respect to the video terminal **106** (step **S1708** of FIG. **17**), and the VCID exchange message is sent toward the video terminal **106** by the method similar to those described above (step **S1709** of FIG. **17**).

In response to the VCID message (propose message), if it is acceptable, the video terminal **106** returns ACK (propose ACK). Then, the flow exchange message of the FANP is received through the asynchronous channel or asynchronous write, and recognizes that this is a message destined to this video terminal **106**. The fact that the contained data is the MPEG stream can be recognized according to the communication attribute field, but this can also be done by the other methods. As an example, the video terminal **106** may be made so that it is possible to ascertain the attribute of data that will be arriving from this channel according to the flow ID value.

For example, this can be realized by implicitly entering an information as to which port numbers are the transport stream of MPEG2, etc. in advance. Also, as the e-ACK flag is erected, the need to transmit the end-to-end ACK message indicating that the FANP message was accepted, with respect to the transmission terminal (i.e., the video server **101**), can also be recognized.

When it is acceptable, a re-direct message as shown in FIG. **27** is returned to the previous hop 1394 gateway **105** as the exchange of the flow exchange message.

The re-direct message is sent to the 1394 gateway **105** by using the asynchronous channel or asynchronous write of the second 1394 bus **113**.

As shown in FIG. **27**, the re-direct message has values of the VCID and the flow ID entered therein, so that the 1394 gateway **105** that received this message can recognize the offer message that was earlier transmitted from it to which this re-direct message corresponds.

It is also possible to use a scheme in which the end-to-end ACK signal is contained in this re-direct message, and as described below, when the FANP node that received this end-to-end ACK transmits to the re-direct message to the upstream side, that FANP node also transmits this re-direct message by erecting the end-to-end ACK signal.

In this way, it becomes possible to return the end-to-end ACK from the final terminal (the video terminal **106** in this embodiment) to the transmission terminal (the video server **101**). Note that there is no need to mount this end-to-end ACK on every re-direct message, and it is possible to use a scheme in which it is also transmitted to the upstream side only when it is received from the downstream side, for example.

The 1394 gateway **105** that received the re-direct message interprets that the earlier transmitted offer message was accepted. At this point, the 1394 gateway **105** recognizes that, hereafter, when the MPEG video for example is entered from the isochronous channel **2103** of the first 1394 bus **112**, it is necessary to transmit it further to the isochronous channel **2104** of the second 1394 bus **113**. Consequently, the IP/FANP processing unit **1404** makes the necessary setting (the initialization of the internal queue, the setting of the correspondence table of FIG. **19**, etc.) by which the data from the isochronous channel **2103** will be forwarded to the 1394 switch unit **1408** at the first MUX/DEMUX **1403**, and this data will be transmitted at the 1394 switch unit **1408** to the second MUX/DEMUX **1405** by applying only the datalink layer processing (that is, the switching of the 1394 frames among the 1394 buses by checking only the channel number or the destination address with the specific register offset).

In addition, the setting is also made with respect to the second MUX/DEMUX **1405** so that this data will be transmitted to the isochronous channel **2104** of the second 1394 bus **113**.

Moreover, the re-direct message is also transmitted to the previous hop NIU **104**.

At this point, when the e-ACK is erected in the re-direct message from the downstream side, the e-ACK is also erected there.

These steps are repeated up to the video server **101**. Note that the NIU **104** has the setting (the setting of the correspondence table for enabling the direct conversion from the VPI/VCI value of the ATM to the channel number of the 1394) for the ATM/1394 transfer unit **1008** by which it is possible to carry out the data forwarding at the datalink layer (without using the processing at the IP/FANP processing unit) from the ATM connection **2102** to the isochronous channel **2103** of the first 1394 bus **112** simply by the datalink switching from the ATM to the 1394.

Also, at the cell switch router **103**, the direct ATM layer connection (the setting of the VCI table) is made for the ATM connection **2101** and the ATM connection **2102** by the internal ATM switch **602**. At this point, all the datalink connections from the video server **101** to the video terminal **106** are established. This is shown in FIG. **28**.

In addition, by the arrival of the end-to-end ACK, it is indicated that the video reception preparation is ready at the video terminal **106** which is the target terminal (step **S1710** of FIG. **17**).

Here, prior to the connection establishing, the video server **101** can start transmitting video data to the VC **2101** by which the FANP message exchange was carried out. The transmitted video data reaches to the video terminal **106** basically without receiving any intermediate IP layer processing, along the connection of FIG. **28**.

Note that the data to be transmitted can be either raw MPEG data or MPEG data encapsulated within IP packets (that is, the so called MPEG-over-IP).

In the former case, the MPEG data will be transmitted according to the MPEG-over-ATM specification standardized by the ATM forum (SAAVer. **1** specification) while the MPEG data are transmitted on the ATM, and according to the MPEG-over-1394 specification standardized by the digital VTR conference while the MPEG data are transmitted on

the 1394. Also, in this case, at the ATM/1394 transfer unit **1008** of the NIU **104**, the transfer and the format conversion between the MPEG-over-ATM and the MPEG-over-1394 will be carried out. In this case, the end-to-end datalink layer connection set up for the purpose of the raw MPEG video data transfer is made by using the FANP. In this case, the triggering of these processings can be done by the VPI/VCI value which is the datalink layer header.

As described, according to this first embodiment, the following effects can be realized.

(1) Even under the environment in which different types of network technologies (datalink technologies) such as ATM and IEEE 1394 are mixedly present, it becomes possible to carry out the data transfer by establishing the end-to-end datalink layer connection.

(2) In a case of carrying out the data transfer at the datalink connection point, there is a degree of freedom in that it is possible to control the inter-connecting device such that the datalinks can be connected directly, without using the processing by the IP/FANP processing unit, so that it becomes possible to carry out the high speed data transfer wherever necessary.

(3) Even if the data to be transmitted is not the IP packet, it is possible to realize the route setting for it by using the IP/FANP for the control of the connection establishing, so that it becomes possible to realize any desired data transfer with respect to any desired location.

(4) In the FANP node, the routing protocol such as OSPF is not operated unlike the conventional router, so that there is basically no need to support the dynamical routing, and therefore the processing load is lighter compared with the conventional router.

Now, once the directly connected connections are established as shown in FIG. **28**, these end-to-end datalink layer connections can be maintained fixedly.

In this case, as long as the explicit connection release control message does not come, these connections will be continued permanently so that the connections will be maintained in a hard state. In this case, at the end of the communication, the sender, the receiver, or the intermediate node transmits the connection release message among the flow exchange messages of the FANP, so as to urge the connection release to each FANP node.

Here, the case in which the sender requests the connection release can arise at the end of the program, or when the reserved time is over. Also, the case in which the receiver requests the connection release can arise when the user wishes to disconnect that connection voluntarily, or due to the reception terminal setting (such as the timer reservation). Also, the case in which the intermediate node requests the connection release can arise when a cable disconnection, a power supply disruption, etc. is detected at an intermediate location.

As shown in FIG. **29**, the connection release is carried out by the exchange of the release message and the release ACK message among the flow exchange messages.

The node **2901** that carries out the connection release transmits the release message to the neighboring FANP node **2902**, and the FANP node **2902** that received this message transmits the release ACK message. Here, the connection release is merely the releasing of the "datalink connections inter-connected" state at the FANP node (the releasing of a pipe indicated by dashed lines in FIG. **28**), and the releasing of the VC in the ATM network or the datalink layer connection such as the isochronous channel in the IEEE 1394 is not absolutely necessary.

When some node receives the connection release request from the upstream or downstream side, and Judges that it is meaningless to maintain the connection to its downstream or upstream side from the overall viewpoint (because the data transfer beyond there will be no longer maintained due to that connection release), that node will continue to make (forward) the connection release request further to its downstream or upstream side.

Also, as shown in FIG. **30**, the connection may be maintained in a soft state. In the soft state, the downstream node regularly transmits the re-direct message to the upstream node so that the upstream node recognizes that the downstream node is capable of continuing to receive data at a corresponding datalink connection, and continues to send data into that datalink connection. This transmission of the re-direct message is carried out at the prescribed refresh interval as indicated in FIG. **30**. Then, when the re-direct message did not reach to the upstream node after the prescribed refresh period elapsed (a state indicated as **3002** in FIG. **30**), the upstream node judges that the downstream node became impossible to receive data at that datalink connection so that the upstream node stops the data transfer to that datalink connection.

The downstream node transmits the re-direct message regularly to the upstream node as long as data is flowing in that datalink connection. The re-direct message is transmitted at the refresh interval indicated by the offer message. When no data is flowing, the re-direct message is not transmitted.

By transmitting the re-direct message in this manner, it is possible for the upstream node to confirm that the datalink connection (**2101**, **2102**, **2103** or **2104**) related to that re-direct message is operating normally and that the downstream node is active.

Here, when the upstream node is broke down for some reasons, in order to avoid leaving the downstream node in a state of having that datalink connection set up, this datalink connection is released from the downstream node when a state of having no data flowing in that datalink connection continues for a certain period of time at the downstream node.

Also, when the data transferred by that datalink connection is the IP packet, in conjunction with the end of the IP packet transfer by that datalink connection, it is also possible to carry out the switching of that IP packet transfer from that dedicated datalink connection to the default VC (default channel=asynchronous channel or asynchronous write).

Next, a method for using the flow ID as described above will be described.

In a case of transmitting the IP packets through the datalink layer connections established according to the present invention, a typical method is to use the flow ID given by "IP address of the transmitting terminal+IP address of the receiving terminal" or "IP address of the transmitting terminal+port number of the transmitting terminal+IP address of the receiving terminal+port number of the receiving terminal".

In a case of entering the IP packets into the datalink layer connections which are directly connected by this method, it suffices for the intermediate FANP node to distinguish the IP flows to be entered by entering only those IP packets which have a specific set of "source address+destination address" or "source address+source port number+destination address+destination port number" among the IP packets. Note that this operation may be done by any intermediate FANP node (usually a router). Also, this directly connected

connections may be interrupted anywhere. As such, what value is to be used as the flow ID value can be ascertained by each FANP node according to the flow ID type number.

Next, a case of entering the raw data (such as MPEG data, for example) rather than the IP packets into the directly connected datalink layer connections will be considered.

First, consider a case of entering "destination IP address+ destination port number" as the flow ID. If the both sides of the transmitting and receiving terminals acknowledge in advance a rule like "when a value in a certain range is used as a value of the destination port number, raw data rather than IP packets will be entered into the directly connected datalink layer connections", then by looking at the destination port number of the flow ID, the FANP node can recognize that data that will subsequently flow in are not the IP packets. In this case, there may be no need to transmit the information regarding the communication attribute.

Next, consider a case of entering "destination IP address+a unique ID determined by the transmitting terminal" as the flow ID. Here, this "unique ID determined by the transmitting terminal" is a unique ID that is determined and used by the transmitting terminal by attaching some meaning. Similarly as in the previous case, it is also possible to consider a method in which both sides of the transmitting and receiving terminals acknowledge in advance a rule like "when a value in a certain range is used as a value of the unique ID, specific raw data will be entered into the directly connected datalink layer connections".

The flow ID will be flowing from each source when the information outputted from two or more sources (which may not be outputted simultaneously) are merged at some FANP node and outputted at the identical datalink layer connection from that FANP node.

It is also possible to consider a method in which an identical flow ID can be attached to the information (flow) to be entered into that datalink, and used as an identifier by means of which the information from different sources can be collected into one datalink layer connection.

This case will be described in detail with reference to FIG. **31**, which shows the network that has basically the similar configuration as that of FIG. **1** (and therefore the descriptions of the constituent elements will be omitted here), but it differs from the network of FIG. **1** in that a plurality of video servers (two video servers **3121** and **3122** in FIG. **31**, for example) are provided.

The video data delivery from these video servers is also controlled by the program guide delivery server (guide server) **3102**. At this point, the guide server **3102** notifies some specific number to either one of the video servers **3121** and **3122** for carrying out the delivery, as a control of the video data delivery with respect to the same video terminal **3106** at the same connection time, in a sense of "use this number as the flow ID (or its part)". Here, the video data delivery from different video servers at the same connection time occurs in such a case where a user of the video terminal **3106** changes the video channel number (program) to be watched, or a case in which the different video servers provide different programs respectively.

In such a case, when the plural video servers throw the identical flow ID (or its part), it becomes possible for the FANP node (the cell switch router **3103** in this case) to ascertain that both of these flows are to be forwarded to the identical datalink connection **3109**. Consequently, even in a case where the channel switching by the user (that is, the changing of the video server) occurs, there is no need to establish a new datalink layer connection at the downstream side of that FANP node (the cell switch router **3103** in this case), and it becomes possible to transmit the respective data to appropriate datalink layer connections.

Note that, in this case, when the re-direct message comes from the downstream side, there is a need to transmit it to a plurality of upstream side FANP nodes (the video servers **3121** and **3122** in this case) which are related by the FANP.

Also, it is necessary for a switch that connect the datalink layers together (The ATM switch within the cell switch router **3103** in this case) to have a connection form of multiple-to-one (that is, a form by which data from different input datalink connections are to be collectively outputted to one output datalink connection). It is also possible to presuppose that data will not be transmitted from a plurality of transmitting terminal simultaneously.

In addition, a portion described as the 1394 bus in the above description may be replaced by 1394 networks interconnected by 1394 gateways or 1394 bridges.

Moreover, the router has been described above a something which is provided at the CATV head-end outside the home, but of course it is also possible to place it inside the home.

In this embodiment, the description has been given for an exemplary case in which the reservation of the bandwidth from the video server **101** to the video terminal **106** is made by using the extended FANP. In contrast, it is also possible to carry out the bandwidth reservation control in the existing router (the cell switch router **103** in this embodiment) by using the signaling protocol in the network layer such as the RSVP (Resource Reservation Setup Protocol) or ST2 (Stream Transport Protocol-2), and carry out the bandwidth reservation control by using the extended FANP of the present invention within the IP subnet, that is, between the cell switch router **103** to the video terminal **106**. The sequence in this case is shown in FIG. **32**.

FIG. **32** shows an exemplary case in which the RSVP is used as the signaling protocol in the network layer. Note that, in FIG. **32**, the detailed message exchanges such as those for the propose message and the pending message are omitted for simplicity.

For the bandwidth reservation control among the transmitting terminal (video server **101**), the router (cell switch router **103**) and the video terminal **106**, the signaling protocol such as RSVP or ST2 is used, and the bandwidth reservation control within the subnet among them is carried out by using the extended FANP of the present invention. Namely, the extended FANP of the present invention is used for the purpose of the datalink connection control between the RSVP nodes. By means of this, the existing router becomes the de facto standard between the internet routers, and the widely used bandwidth reservation protocol between the terminal and the router or between one router and another such as ST2 or RSVP can be used, so that it becomes possible to realize the bandwidth reservation within the subnet that has not been used conventionally, in particular the bandwidth control in the subnet under the heterogeneous environment in which the virtual connection type networks are mixedly present, by using the extended FANP of the present invention.

Second Embodiment

Next, with references to FIG. **33** to FIG. **44**, the second embodiment of the present invention will be described in detail.

This second embodiment is directed to a communication network system formed by two or more 1394 buses, nodes

called half gateways which are connected to respective buses, and a various type of network for connecting these half gateways.

FIG. **33** shows an exemplary overall configuration of a communication network system (a home network system for connecting various electric devices inside the home, for example) according to this second embodiment. As shown in FIG. **33**, this communication network system comprises a transmitting terminal **4001**, a first half gateway **4002**, a second half gateway **4003**, a receiving terminal **4004**, a first 1394 bus **4011**, an Ethernet cable **4012**, and a second 1394 bus **4013**.

Here, it is assumed that the entire system constitutes a home network within the same home, similarly as in the first embodiment. Consequently, among the devices contained in this system, those which are the IP nodes are assumed to be belonging to the same IP subnet. Here, this IP subnet is assumed to have an IP subnet address N, and the IP addresses of the nodes are assumed to be N. **1** for the transmitting terminal **4001**, N. **2** for the first half gateway **4002**, N. **3** for the second half gateway **4003**, and N. **4** for the receiving terminal **4004**.

Also, the 1394 addresses and the Ethernet addresses of these nodes are as shown in FIG. **33**.

Each of the transmitting terminal **4001**, the first half gateway **4002**, the second half gateway **4003** and the receiving terminal **4004** of this embodiment is the FANP node as described in the first embodiment which has the extended FANP function of the present invention.

The transmitting terminal **4001** is also the IP terminal as well, and has functions for exchanging IP packets with the receiving terminal **4004** and delivering video with respect to the receiving terminal **4004**.

The video delivery may be carried out by mounting the video information on the IP packets, or by transmitting the video data directly into the specified 1394 isochronous channel. Further details in this regard will be described below.

The first half gateway **4002** and the second half gateway **4003** are devices for connecting the 1394 buses together. Namely, they are devices to be used in connecting the first 1394 bus **4011** and the second 1394 bus **4013**. Such a situation may arise when the first 1394 bus **4011** and the second 1394 bus **4013** are far apart from each other so that it is difficult to unify them into a single 1394 bus, for example.

Namely, according to the specification of the 1394, it is not preferable for the 1394 buses to use a long cable. In such a case, the half gateways of the present invention can be connected to the respective 1394 buses and these half gateways can be connected together by a dedicated cable, so as to realize the connection between the 1394 buses. Further details in this regard will be described below.

The receiving terminal **4004** is also the IP terminal as well, and has functions for exchanging IP packets with the transmitting terminal **4001**, and receiving video delivered from the transmitting terminal **4001**.

The first half gateway **4002** and the second half gateway **4003** are connected by the Ethernet cable **4012**. Namely, in this embodiment, the data exchanges between two half gateways are to be carried out in terms of the Ethernet frames.

FIG. **34** shows an exemplary internal configuration of the half gateway **4002** or **4003**.

As shown in FIG. **34**, this half gateway comprises a 1394 physical processing unit **4101**, a 1394 link processing unit **4102**, a 1394 control unit **4103**, a first MUX/DEMUX **4104**, an IP/FANP processing unit **4105**, a 1394/Ethernet transfer unit **4106**, a second MUX/DEMUX **4107**, and an Ethernet interface unit **4108**.

The 1394 physical processing unit **4101**, the 1394 link processing unit **4102**, and the 1394 control unit **4103** carry out the physical layer processing, the link layer processing, and the bus management and the transaction layer processing, respectively, for the connected 1394 bus (**4011** or **4013**), as well as the exchanges of data (PDU from a viewpoint of 1394) with the IP/FANP processing unit **4105** or the 1394/Ethernet transfer unit **4106**, using the 1394 frames to be transmitted or received that are passing through the first MUX/DEMUX **4104** and the second MUX/DEMUX **4107**.

The IP/FANP processing unit **4105** has functions for carrying out the routing based on the IP address, the routing table management, the FANP processing, the ARP processing, etc., for the received IP packets, FANP packets, ARP packets, etc.

The 1394/Ethernet transfer unit **4106** has a function for attaching a specific Ethernet header to data received from the 1394 side, especially data received through the isochronous channel, by using its isochronous channel number or the specific register offset on the destination address as a key, and transmitting it to the Ethernet side, and a function for transmitting data received from the Ethernet side to a specific isochronous channel or the specific address offset on the 1394 side by using its header information as a key. Namely, the data forwarding at this processing unit is carried out by using only the datalink layer processing without using the IP layer processing.

For example, a table of correspondence between the MAC address value and the channel number of the isochronous channel of the 1394 bus is produced in a form of a correspondence table as shown in FIG. **35** (in a case of transmitting data received from the 1394 side to the Ethernet side) or FIG. **36** (in a case of transmitting data received from the Ethernet side to the 1394 side), for example. Here, the mapping for each correspondence table is made by the IP/FANP processing unit **4105**. A similar correspondence table can be configured between the MAC address value and the 1394 destination address with a specific register offset value.

The Ethernet interface unit **4108** is an interface with respect to the physically connected Ethernet, and carries out the encapsulation and decapsulation of data to be exchanged with the second MUX/DEMUX **4107** and the Ethernet frames.

Next, for an exemplary case of transmitting video from the transmitting terminal **4001** to the receiving terminal **4004**, the operation sequence in time order will be described with references to FIG. **37** and FIG. **38**.

FIG. **37** shows a sequence for the ARP (Address Resolution Protocol).

First, the transmitting terminal **4001** transmits the ARP request packet to the first 1394 bus **4011** in order to carry out the address resolution for ascertaining the datalink layer address of the receiving terminal **4004** from its IP address (step S**4201**). As described in the first embodiment, this ARP request is broadcasted on the local bus (that is, the first 1394 bus **4011**).

The first half gateway **4002** which is the FANP node that received this ARP request forwards this ARP request to the Ethernet cable **4012**, upon confirming that the requested address is not the own address and that another port (that is,

the Ethernet cable **4012**) different from the port through which this ARP is entered (that is, the first 1394 bus **4011**) is connected (step S**4202**). Here, the destination Ethernet address is the Ethernet broadcast address.

The second half gateway **4003** that received this ARP request also forwards this ARP request to the second 1394 bus **4013** through a procedure in which the procedure of the first half gateway **4002** is reversed (step S**4203**). At this point, this ARP request may be transmitted in a form of the broadcast to the "local bus".

The receiving terminal **4004** that received this ARP request enters the own 1394 address (EUI**64** and "bus ID+physical ID") into this packet and returns this packet to the second 1394 bus **4013** as the ARP response (step S**4204**). At this point, the destination address of this ARP response is the 1394 address of the second half gateway **4003**.

The second half gateway **4003** which received this ARP response enters the own Ethernet address into a field for the resolved address, so as to carry out the deputy response with respect to the first half gateway **4002** (step S**4205**). At this point, the destination is the Ethernet address of the first half gateway **4002**. Also, the second half gateway **4003** recognizes that a terminal having the IP address of the receiving terminal **4004** exists on the second 1394 bus **4013** side, and registers this fact into the internal routing table.

The first half gateway **4002** that received this ARP response enters the own 1394 address into a field for the resolved address, and carries out the deputy response with respect to the transmitting terminal **4001** (step S**4206**). At this point, the destination is the 1394 address of the transmitting terminal **4001**. Also, the first half gateway **4002** recognizes that a terminal having the IP address of the receiving terminal **4004** exists on the Ethernet **4012** side, and registers this fact into the internal routing table.

In this manner, the transmitting terminal **4001** can ascertain that it suffices to transmit the IP packets destined to the receiving terminal **4004** with respect to (the 1394 address of) the first half gateway **4002**.

Note that FIG. **37** shows a case of the address resolution in which the ARP request reaches to the target node once and then the ARP response is sequentially returned backwards from there, but it is not necessarily limited to this case, and it is also possible to use a case of the address resolution in which the intermediate node directly carries out the address resolution when the intermediate node already has an information on the target node.

Now, the transmitting terminal **4001** already recognizes that it is the FANP node itself and that what is to be transmitted from now on with respect to the receiving terminal **4004** is the video. Consequently, the transmitting terminal **4001** intends that the video to be transmitted from now on will be forwarded by the datalink processing alone without using the IP processing at the intermediate FANP nodes.

To this end, after the confirmation of the initial setting and the coding scheme using the IP packets and the confirmation of the video reception capability with respect to the receiving terminal **4004**, the transmitting terminal **4001** proceeds to the video transmission preparation. FIG. **38** shows the sequence for this operation.

First, the transmitting terminal **4001** accesses the register of the isochronous resource manager on the first 1394 bus **4011** to reserve the bandwidth necessary for the video transmission and acquire the isochronous channel number, between the transmitting terminal **4001** and the first half gateway **4002** (step S**4401**). FIG. **39** shows the isochronous channel **4301** obtained at this point.

Then, the transmitting terminal **4001** transmits the propose message of the FANP with respect to the first half gateway **4002** through that isochronous channel **4301**. This propose message is transmitted by entering the own ESI and sequence number as the VCID and the IP address (N. **4**) of the receiving terminal **4004** as the target IP address (step S**4402**).

The first half gateway **4002** that received this propose message recognizes that it is the FANP packet (propose message), confirms the final destination IP address (the receiving terminal **4004**) from the target IP address, and confirms that this address exists on the Ethernet cable **4012** side by referring to the internal routing table. Then, the first half gateway **4002** enters the own IP address into the propose ACK message and returns it to the asynchronous channel or asynchronous write of the first 1394 bus **4011** (step **4403**).

The transmitting terminal **4001** that received this propose ACK message transmits the offer message to the asynchronous channel or asynchronous write of the first 1394 bus **4011**, by entering the IP address of the first half gateway **4002** as the destination IP address, entering the VCID described above, entering the IP address of the receiving terminal **4004** which is the final destination into the flow ID similarly as in the first embodiment, and containing the necessary bandwidth value and the end-to-end ACK request (step S**4404**). At this point, the destination 1394 address is obviously the 1394 address of the first half gateway **4002**.

The first half gateway **4002** that received this offer message recognizes that it is the FANP packet, confirms the final destination IP address (the receiving terminal **4004**) from the flow ID, and re-confirms that this address exists on the Ethernet cable **4012** side.

Here, in order to make it possible for the second half gateway **4003** to transmit the data to be transmitted directly to the isochronous channel or the destination address with the specific register offset value on the 1394 bus **4013** by only confirming the Ethernet header value, a value different from the Ethernet address "A**2**" unique to the second half gateway **4003** is used as the destination address of the Ethernet frame to be transmitted. This value can be any value as long as it is different from values of the Ethernet addresses of the first half gateway **4002** and the second half gateway **4003**, that is, the address not used on the Ethernet cable, and it is different from values currently used for the direct forwarding at the datalink layer for the other flows.

For example, when the Ethernet address value selected by the first half gateway **4002** here is "#A", only the video information directed to the receiving terminal **4004** will be mounted on every subsequent Ethernet frame which has "#A" as the destination Ethernet address. This is equivalent to having the virtual connection with "#A" as VCI established between the first half gateway **4002** and the second half gateway **4003**. This is shown in FIG. **39** as the connection **4302**.

Note that the half gateways **4002** and **4003** have the initial setting by which a frame destined to any Ethernet address will be handed to the IP/FANP processing unit **4105** once along with its destination Ethernet address value, except when it is a frame which passes through the 1394/Ethernet transfer unit **4106**. By this setting, it becomes possible for the IP/FANP processing unit **4105** to make the setting according to the content of the FANP packet by which the switching at the datalink layer is carried out by making appropriate setting to the 1394/Ethernet transfer unit **4106**, for the necessary Ethernet address.

The first half gateway **4002** transmits the propose message of the FANP through the connection **4302** of FIG. **39** (step S**4406**). This propose message is transmitted by entering the own ESI and sequence number as the VCID and the IP address (N. **4**) of the receiving terminal **4004** as the target IP address.

The second half gateway **4003** that received this propose message recognizes that it is the FANP packet (propose message), confirms the final destination IP address (the receiving terminal **4004**) from the target IP address, and confirms that this address exists on the second 1394 bus **4013** side by referring to the internal routing table. Then, the second half gateway **4003** returns the propose ACK message to the Ethernet cable **4012**, by entering the own IP address as the target IP address and the Ethernet address of the first half gateway **4002** as the destination address (step S**4407**).

As can be seen from this description, a case of transmission using the usual Ethernet address as the destination header of the Ethernet frame corresponds to a case of transmission by the "default VC" in the FANP.

The first half gateway **4002** that received this propose ACK message transmits the offer message onto the Ethernet cable **4012**, by entering the IP address of the second half gateway **4003** as the destination IP address, entering the VCID described above, entering the IP address of the receiving terminal **4004** which is the final destination into the flow ID, and containing the necessary bandwidth value and the end-to-end ACK request (step S**4408**). At this point, the destination Ethernet address is the Ethernet address of the second half gateway **4003**.

The second half gateway **4003** that received this offer message recognizes that it is the FANP packet, confirms the final destination IP address (the receiving terminal **4004**) from the flow ID, and re-confirms that this address exists on the second 1394 bus **4013** side.

Then, the second half gateway **4003** reserves the bandwidth and the isochronous channel number or the destination address with the specific register offset by the setting in the register of the isochronous resource manager of the second 1394 bus, in order to transmit the video signals by reserving the necessary bandwidth up to the receiving terminal **4004** (step S**4410**). FIG. **39** shows the isochronous channel **4303** obtained at this point.

Then, the second half gateway **4003** transmits the propose message of the FANP through this isochronous channel **4303** (step S**4411**).

The receiving terminal **4004** that received this propose message transmits the propose ACK message to the second half gateway **4003** if it is acceptable (step S**4412**).

Then, the second half gateway **4003** transmits the offer message of the FANP to the receiving terminal **4004** (step S**4413**).

When the reception is possible, the receiving terminal **4004** transmits the re-direct message to the upstream FANP node (the second half gateway **4003** in this case) by setting the end-to-end ACK flag ON (step S**4414**). This setting of the end-to-end ACk flag is the processing related to the fact that the end-to-end ACK request is contained in the offer message of the FANP transmitted to the receiving terminal **4004** and that this terminal is the final terminal.

The second half gateway **4003** that received this re-direct message judges that the preparation for the isochronous channel use on the downstream side (the receiving terminal **4004** in this case) is ready, and makes the setting by which the direct datalink layer forwarding can be carried out for the SDU (Service Data Unit) of the frame that arrives with the Ethernet address #A (**4302**) without using the processing by the IP/FANP processing unit **4105** at the 1394/Ethernet transfer unit **4106** inside the second half gateway **4003**. By this setting, for a frame that arrives with the specific Ethernet address "#A", its SDU can be transmitted to the isochronous channel **4303** directly by referring to the correspondence table as shown in FIG. **36**, so that the efficiency and the speed of the data forwarding processing can be improved considerably.

Also, the above described processing does not use the processing at the IP/FANP processing unit **4105** so that the reduction of the load on the IP/FANP processing unit **4105** and the load distribution can be realized simultaneously. In addition, it is also possible to transmit data which is not an IP packet.

The second half gateway **4003** transmits the re-direct message to the upstream FANP node (the first half gateway **4002** in this case) (step S**4415**). At this point, the end-to-end ACK flag is erected in the re-direct message from the downstream side so that the end-to-end ACK flag is set ON.

In this manner, the re-direct message is delivered to the transmitting terminal **4001** through the second half gateway **4003** and the first half gateway **4002**.

At the first half gateway **4002**, the isochronous channel **4301** and the direct conversion into the Ethernet frame **4302** with the Ethernet address "#A" are set to the 1394/Ethernet transfer unit **4106**. Also, at a time of forwarding the re-direct message, the re-direct message is delivered by using the asynchronous channel or asynchronous write of each 1394 bus or the formal Ethernet address "**A1**" on the Ethernet.

When the re-direct message with the end-to-end ACK flag erected is received at the transmitting terminal **4001** in this manner (step S**4416**), the transmitting terminal **4001** can confirm that the isochronous channel **4301** was directly connected at the datalink layer level up to the receiving terminal **4004**. Then, the transmitting terminal **4001** starts the video data transmission through the isochronous channel **4301** (step S**4417**).

The video data can be transmitted through the connection **4302** and the isochronous channel **4303** to the receiving terminal **4004** by the datalink layer processing alone, without using the processing by the IP/FANP processing unit **4105** at the intermediate nodes of the half gateways **4002** and **4003**

Note that the video information to be transmitted here may be the video data encapsulated within the IP packet similarly as in the first embodiment, or the video data directly mounted on the 1394 isochronous channel (or the Ethernet frame **4302** with the destination Ethernet address "#A"). Also, the video information may be transmitted in a form of the 1394 frame directly mounted on the Ethernet frame.

When the maintaining of the connection is realized by maintaining the soft state similarly as in the first embodiment, the above described re-direct message is regularly transmitted to the upstream direction. When this re-direct message does not arrive for a certain period of time or when an explicit message for disconnecting the connection (the release message) comes from the upstream direction, this soft state is released and the setting of the 1394/Ethernet transfer unit **4106** regarding that direct datalink layer connection is also cleared.

As described, by using a plurality of half gateways (**4002**, **4003**) and the Ethernet cable (**4012**) that connects them, it becomes possible to carry out the communication by interconnecting a plurality of 1394 buses by the half gateways.

FIG. **40** shows an exemplary style of using the half gateways and the Ethernet cable. As shown in FIG. **40**, a 1394 inter-connection cable has a physical shape in which a long Ethernet cable **4503** is connected between two half gateways **4002** and **4003** in advance. This cable portion may be connected by an electric cable such as UTP5 or coaxial cable, or by an optical cable such as a plastic optical fiber. It should be noted however that the transmission scheme of the physical layer is supposed to obey the Ethernet standard.

Also, to the respective half gateways, the 1394 connectors **4501** and **4502** are connected through relatively short cables (dedicated 1394 cables). Here, the dedicated 1394 cables are connected so that the power supply to the half gateways **4002** and **4003** can be made through the respective 1394 connectors **4501** and **4502** and this 1394 cable. Consequently, the system of FIG. **40** requires no special power supply. From a viewpoint of a user who wishes to inter-connect two 1394 buses, this implies that the connection is basically completed by simply connecting one end (**4501**) of the cable to the first 1394 bus **4011** and the other end (**4502**) of the cable to the second 1394 bus **4013**, so that the convenience regarding the connecting operation can be improved remarkably.

Also, the 1394 cable basically has an upper limit of 4.5 m in length, but according to the present invention, a long cable (such as that of several hundred meters, for example) can be used as a cable for connecting the half gateways **4002** and **4003**, so that it is very useful in a case of connecting the 1394 buses which are far apart from each other.

In the above, an example using a long cable has been described, but as shown in FIG. **41**, it is also possible to connect the half gateways **4002** and **4003** by radio. In FIG. **41**, **4801** and **4802** are 1394 connectors while **4803** and **4804** are radio transceiver devices used for the inter-connection by radio.

In a case of using the MAC frame as the radio transmission scheme, the scheme of this second embodiment is basically applicable directly. When the radio interface is provided between the half gateways in this manner, this connection becomes wireless so that a user can arrange the wiring easily.

Note that the 1394 inter-connection cable is not only applicable to a case of forming the connection between the 1394 half gateways as described above and shown in FIG. **40** and FIG. **41**, but also to a case of realizing the usual 1394 bridge in the half bridge configuration. In that case, the function of the 1394 bridge can be realized by changing those portions of the above description which are described as "specifying the destination IP address" to the processing of the 1394 address.

Note also that, as shown in FIG. **42**, at the transmitting terminal, the MPEG video from the digital satellite broadcast (or the digital CATV) can be received and this MPEG video can be re-formatted into the MPEG-over -1394 format or converted into the raw video data by the MPEG decoder and then transmitted as the data on the isochronous channel of the 1394.

When this implementation is used, even for the video data (or speech data, usual data, etc.) which is not accommodated originally by the transfer packets used at the home such as those of the network layer like the IP packets, the datalink layer frames like those of the IEEE 1394, etc., the data transfer in the home network becomes possible so that it becomes possible to realize the data distribution to the home network without requiring the cable wiring change for the purpose of the video broadcasting.

FIG. **43** shows an exemplary internal configuration of the transmitting terminal **4901** for realizing this implementation. In FIG. **43**, the transmitting terminal **4901** comprises a satellite broadcast receiving interface unit **9001**, an MPEG data format conversion unit **9002**, an IP/FANP processing unit **9003**, a MUX/DEMUX **9004**, and a 1394 interface unit **9005**.

The satellite broadcast receiving interface unit **9001** is an interface for receiving data from the satellite broadcast, which transmits the data after the data formatting to the MPEG data format conversion unit **9002**.

The MPEG data format conversion unit **9002** converts the transmitted MPEG data from the MPEG data format suitable for the satellite broadcast to the MPEG data format on the IEEE 1394, i.e., the MPEG-over-1394, and transmits it to the MUX/DEMUX **9004**. Here, the de-scrambling processing, etc. may also be carried out in addition.

The IP/FANP processing unit **9003** and the 1394 interface processing unit **9005** have the similar functions as those described above so that their description will be omitted here.

At the MPEG data format conversion unit **9002**, the appropriate format conversion is applied to the transmitted MPEG data so that the MPEG data from the satellite broadcast can be transmitted to the video terminal through the 1394.

FIG. **44** shows an exemplary internal configuration of the transmitting terminal **4901** in a case of decoding the MPEG data received from the satellite broadcast at the transmitting terminal **4901**, and forwarding the raw video data to the video terminal through the 1394 bus.

FIG. **44** differs from FIG. **43** in that the MPEG decoding is carried out at the MPEG decoding unit **9102** so that the raw video data is transmitted to the 1394 bus.

When the MPEG decoding unit **9102** or the MPEG data format conversion unit **9002** is equipped with a function for processing several channels simultaneously, it becomes possible to realize the distribution of the video information in several channels simultaneously to the home network, so that it is very useful in a case where it is desirable to watch a plurality of video programs as in a case where a plurality of family members watch the television simultaneously.

Note here that the MPEG decoding unit **9102** and the MPEG data format conversion unit **9002** may or may not carry out the encapsulation of the video data within the IP packet.

It is to be noted that the "transmitting terminal" in the above description can be provided in a form of what is generally known as "set-top box".

It is also to be noted that this second embodiment has been described for an exemplary case of using the IEEE 1394 bus, but this second embodiment is also applicable to the other datalink layer technology such as the ATM, for example. In such a case, it suffices to use the VPI/VCI value instead of the channel number.

Third Embodiment

Next, with references to FIG. **45** to FIG. **50**, the third embodiment of the present invention will be described in detail.

This third embodiment is directed to a communication network system formed by two or more 1394 buses, that is a communication network system formed by nodes called half gateways which are connected to the respective 1394 buses, and a network for connecting these half gateways.

Here, an exemplary case of using the Ethernet as a network for connecting the half gateways, and providing an Ethernet switch having a plurality of FANP functions between the half gateways will be described.

FIG. **45** shows an exemplary overall configuration of a communication network system (a home network system for connecting various electric devices inside the home, for example) according to this third embodiment. As shown in FIG. **45**, this communication network system comprises a transmitting terminal **5001**, a first half gateway **5002**, a FANP Ethernet switch **5003**, a second half gateway **5004**, a receiving terminal **5005**, a first 1394 bus **5011**, a first Ethernet cable **5012**, a second Ethernet cable **5013**, and a second 1394 bus **5014**.

Here, it is assumed that the entire system constitutes a home network within the same home, similarly as in the first embodiment. Consequently, among the devices contained in this system, those which are the IP nodes are assumed to be belonging to the same IP subnet. Here, this IP subnet is assumed to have an IP subnet address N, and the IP addresses of the nodes are assumed to be N. **1** for the transmitting terminal **5001**, N. **2** for the first half gateway **5002**, N. **3** for the FANP Ethernet switch **5003**, N. **4** for the second half gateway **5004**, and N. **5** for the receiving terminal **5005**.

Also, the 1394 addresses and the Ethernet addresses of these nodes are as shown in FIG. **45**.

Each of the transmitting terminal **5001**, the first half gateway **5002**, the FANP Ethernet switch **5003**, the second half gateway **5004** and the receiving terminal **5005** of this embodiment is the FANP node as described in the first embodiment which has the extended FANP function of the present invention.

Here, the transmitting terminal **5001**, the first half gateway **5002**, the second half gateway **5004** and the receiving terminal **5005** have the same functions as the corresponding elements in the second embodiment described above so that their detailed description will be omitted here.

In this embodiment, the first half gateway **5002** and the second half gateway **5004** are connected by the Ethernet cables **5012** and **5013**. Namely, in this embodiment, the data exchanges between two half gateways are to be carried out in terms of the Ethernet frames.

The FANP Ethernet switch **5003** is an Ethernet switch having the FANP functions, and as will be described below, it has a function for taking the entered FANP packet into the internal IP/FANP processing unit (which is realized by looking at the protocol type of the Ethernet frame), and a function for rewriting the Ethernet address of a frame before and after the input/output of the frame, as set up in the internal table in advance, and outputting this frame. The latter function is provided for carrying out the similar operation as the rewriting of the VPI/VCI at the ATM switch node before and after the input/output of an ATM cell.

In this embodiment, the FANP Ethernet switch **5003** (or the internal switch) is in a two-port physical configuration, but it is also possible to construct a multi-port FANP Ethernet switch by the similar construction method and mechanism.

FIG. **46** shows an exemplary internal configuration of the FANP Ethernet switch **5003**. As shown in FIG. **46**, the FANP Ethernet switch **5003** comprises a first Ethernet interface unit **5101**, a first MUX/DEMUX **5102**, an IP/FANP processing unit **5103**, an Ethernet frame switching and Ethernet header rewriting unit **5104**, a second MUX/DEMUX **5105**, and a second Ethernet interface unit **5106**.

The Ethernet interface units **5101** and **5106** are interfaces with respect to the physically connected Ethernets, and carries out the encapsulation and decapsulation of data to be exchanged with the MUX/DEMUXs **5102** and **5105** and the Ethernet frames.

The IP/FANP processing unit **5103** has functions for carrying out the routing based on the IP address, the routing table management, the FANP processing, the ARP processing, etc., for the received IP packets, FANP packets, ARP packets, etc., as well as a function for making appropriate setting to the Ethernet frame switching and Ethernet header rewriting unit **5104**.

The Ethernet frame switching and Ethernet header rewriting unit **5104** has a function for switching an Ethernet frame received from either interface to an appropriate output port by referring to its destination Ethernet address, and a function for rewriting at least a part of the Ethernet address at a time of the above switching according to the setting from the IP/FANP processing unit **5103**. To this end, the Ethernet frame switching and Ethernet header rewriting unit **5104** may have a header conversion table provided therein similarly as in the ATM switch. The Ethernet frame switching and Ethernet header rewriting unit **5104** also has a function for learning the Ethernet address, which functions to refer to a source address of an entered Ethernet frame and store it along with an input port for a certain period of time.

Note that the Ethernet frame that passes through this Ethernet frame switching and Ethernet header rewriting unit **5104** can pass without being applied with the processing by the IP/FANP processing unit **5103**.

Next, for an exemplary case of transmitting video from the transmitting terminal **5001** to the receiving terminal **5005**, the operation sequence in time order will be described with references to FIG. **47** and FIG. **48**.

FIG. **47** shows a sequence for the ARP (Address Resolution Protocol).

First, the transmitting terminal **5001** transmits the ARP request packet to the first 1394 bus **5011** in order to carry out the address resolution for ascertaining the datalink layer address of the receiving terminal **5005** from its IP address (step S**5401**). As described in the second embodiment, this ARP request is broadcasted on the local bus (that is, the first 1394 bus **5011**).

The first half gateway **5002** which is the FANP node that received this ARP request operates similarly as in the second embodiment. As a result, this ARP request is forwarded to the Ethernet cable **5012** by setting the Ethernet broadcast address as the destination address (step S**5402**).

The FANP Ethernet switch **5003** also receives this ARP request, but as it does not have the corresponding IP address, the ARP response will not be sent from there.

Also, this ARP request is forwarded to the second Ethernet cable **5013** through the Ethernet frame switching and Ethernet header rewriting unit **5104**. Note that, in this case (a case where the destination address is the broadcast address), the rewriting of the Ethernet address is not carried out so that the ARP request is forwarded as it is.

The second half gateway **5004** and the receiving terminal **5005** that received this ARP request also operate similarly as in the second embodiment (step S**5403**). Namely, the receiving terminal **5005** that received this ARP request enters the own 1394 address (EUI64 and "bus ID+physical ID") into this packet and returns this packet to the second 1394 bus **5014** as the ARP response (step S**5404**), and this ARP response reaches to the FANP Ethernet switch **5003**. At this

point, the destination address of the Ethernet frame is the Ethernet address "A1" of the first half gateway **5002**.

As described above, the FANP Ethernet switch **5003** has the learning function, and holds the Ethernet address of the first half gateway **5002** and its physical port direction (that is, the first Ethernet cable **5012** side) as a table at a time of the ARP request, so that this ARP response is switched by the Ethernet frame switching and Ethernet header rewriting unit **5104** and reaches to the first half gateway **5002** (step S5405).

Then, as the first half gateway **5002** returns the ARP response (deputy response) (step S5406), this ARP response eventually reaches to the transmitting terminal **5001**.

In this manner, the transmitting terminal **5001** can ascertain that it suffices to transmit the IP packets destined to the receiving terminal **5005** with respect to (the 1394 address of) the first half gateway **5002**.

Next, similarly as in the second embodiment, the transmitting terminal **5001** intends that the video to be transmitted from now on will be forwarded by the datalink processing alone without using the IP processing at the intermediate FANP nodes, and after the confirmation of the initial setting and the coding scheme using the IP packets and the confirmation of the video reception capability with respect to the receiving terminal **5005**, the transmitting terminal **5001** proceeds to the video transmission preparation. FIG. **48** shows the sequence for this operation which will now be described.

Among the operations of the transmitting terminal **5001** and the first half gateway **5002**, the operations for the exchanges of the messages between them (up to the transmission of the pending message of the FANP) are the same as in the second embodiment (step S5501 to step S5505).

The first half gateway **5002** that received the offer message from the transmitting terminal **5001** recognizes that it is the FANP packet, confirms the final destination IP address (the receiving terminal **5005**) from the flow ID, and confirms that this address exists on the Ethernet cable **5012** side. Here, in order to make it possible for the next hop FANP node to carry out the direct datalink layer switching of the data to be transmitted by only confirming the Ethernet header, a value different from the Ethernet address unique to the second half gateway **5004** is used as the destination address of the Ethernet frame to be transmitted. This value can be any value as long as it is different from values of the Ethernet addresses of the first half gateway **5002** and the second half gateway **5004**.

For example, when the Ethernet address value selected by the first half gateway **5002** here is "#A", only the video information directed to the receiving terminal **5005** will be mounted on every subsequent Ethernet frame which has "#A" as the destination Ethernet address. This is equivalent to having the virtual connection with "#A" as VCI established between the first half gateway **5002** and the next hop FANP node (more specifically, the FANP Ethernet switch **5003**). This is shown in FIG. **49** as the connection **5302**.

The first half gateway **5002** transmits the propose message of the FANP through this connection **5302** (step S5506). At this point, a number indicating the FANP is to be entered into the protocol type of the Ethernet frame. Also, this propose message is transmitted by entering the own ESI and sequence number as the VCID and the IP address of the receiving terminal **5005** as the target IP address.

The FANP Ethernet switch **5003** that received this propose message recognizes that it is the FANP packet (propose message) by referring to the protocol type field of the Ethernet frame, and transfers it to the internal IP/FANP processing unit **5103**. Then, the FANP Ethernet switch **5003** confirms that the destination Ethernet address of this Ethernet frame exists on the second half gateway **5004** side, and registers this in relation to the final destination IP address (the receiving terminal **5005**) in the internal routing table. Then, the FANP Ethernet switch **5003** returns the propose ACK message to the first Ethernet cable **5012**, by entering the own IP address as the target IP address and the Ethernet address of the first half gateway **5002** as the destination address (step S5507).

The first half gateway **5002** that received this propose ACK message transmits the offer message onto the first Ethernet cable **5012**, by entering the IP address "N. **3**" of the FANP Ethernet switch **5003** as the destination IP address, entering the VCID described above, entering the IP address "N. **5**" of the receiving terminal **5005** which is the final destination into the flow ID, and containing the necessary bandwidth value and the end-to-end ACK request (step S5508). At this point, the destination Ethernet address is the Ethernet address "A2" of the FANP Ethernet switch **5003**. In this case, a number indicating the FANP may also be entered into the protocol type of the Ethernet frame.

The FANP Ethernet switch **5003** that received this offer message recognizes that it is the FANP packet, and transfers it to the IP/FANP processing unit **5103**. Here, the FANP Ethernet switch **5003** also confirms the final destination IP address (the receiving terminal **5005**) from the flow ID, and confirms that this address exists on the second Ethernet cable **5013** side. Here, also, in order to make it possible for the next hop FANP node (more specifically, the second half gateway **5004**) to carry out the direct datalink layer switching of the data to be transmitted by only confirming the Ethernet header, a value different from the Ethernet address unique to the second half gateway **5004** is used as the destination address of the Ethernet frame to be transmitted.

For example, when the Ethernet address value selected by the FANP Ethernet switch **5003** is "#B", it is equivalent to having the virtual connection with "#B" as VCI established between the FANP Ethernet switch **5003** and the second half gateway **5004** which is the next hop FANP node. This is shown in FIG. **49** as the connection **5303**.

The FANP Ethernet switch **5003** transmits the propose message of the FANP through this connection **5303** (step S5510). Thereafter, the procedure is the same as in the second embodiment.

The FANP Ethernet switch **5003** that received the re-direct message from the downstream side (step S5519) judges that the preparation for the dedicated virtual channel use on the downstream side (the second half gateway **5004** in this case) is ready, and makes the setting by which the direct datalink layer forwarding (Ethernet switching) can be carried out for the Ethernet frame that arrives with the Ethernet address #A from the first Ethernet cable **5012** side without using the processing by the IP/FANP processing unit **5103** at the Ethernet frame switching and Ethernet header rewriting unit **5104** inside the FANP Ethernet switch **5003**. At this point, the setting is also made in the internal Ethernet header conversion table so that the destination Ethernet address will be converted from "#A" to "#B" and this Ethernet frame will be switched to an appropriate output port (the second Ethernet cable **5013** in this embodiment).

By this setting, a frame that subsequently arrives with the specific Ethernet address "#A" from the first Ethernet cable **5012** can be transmitted to the second Ethernet cable **5013** by the direct Ethernet switching upon converting the desti-

nation Ethernet address to "#B" and after the Ethernet header conversion is carried out, so that the efficiency and the speed of the data forwarding processing can be improved considerably.

Also, the above described processing does not use the processing at the IP/FANP processing unit **5103** so that the reduction of the load on the IP/FANP processing unit **5103** and the load distribution can be realized simultaneously.

In addition, it becomes possible to introduce a concept similar to the virtual connection into the Ethernets **5012** and **5013**, so as to enable the above described data forwarding.

In this manner, the FANP Ethernet switch **5003** transmits the re-direct message to the upstream FANP node (the first half gateway **5002** in this case) (step S5520). At this point, the end-to-end ACK flag is erected in the re-direct message from the downstream side so that the end-to-end ACK flag is set ON.

In the subsequent operations, the re-direct message with the end-to-end ACK flag erected is sent to the transmitting terminal **5001** similarly as in the second embodiment (step S5521).

The transmitting terminal **5001** can confirm that the isochronous channel **5301** was directly connected at the datalink layer level up to the receiving terminal **5005**. Then, the transmitting terminal **5001** starts the video data transmission through the isochronous channel **5301** (step S5522).

The video data can be transmitted through **5302**, **5303** and **5304** to the receiving terminal **5005** by the datalink layer processing alone, without using the processing by the IP/FANP processing unit at the intermediate nodes including the half gateways **5002** and **5004** and the FANP Ethernet switch **5003**, so that the guaranteed real-time video information transfer becomes easier.

Note that, similarly as in the second embodiment, the video information to be transmitted here may be the video data encapsulated within the IP packet or the video data directly mounted on the 1394 isochronous channel (or the Ethernet frame with the destination Ethernet address given by "#A" or "#B"). Also, the Ethernet frame may be in a form in which the 1394 isochronous channel frame is mounted directly (or after appropriate processing is applied).

Also, the re-direct message can be used for the purpose of maintaining the soft state similarly as in the second embodiment.

As described, in this third embodiment, by using a plurality of half gateways (**5002**, **5004**) and the Ethernet cables (**5012**, **5013**) and the FANP Ethernet switch **5003** that connect them, it also becomes possible to carry out the communication by inter-connecting a plurality of 1394 buses. In addition, it is also possible to connect three or more half gateways to the FANP Ethernet switch **5003**, for example.

FIG. **50** shows another exemplary style of using the half gateways and the Ethernet cables. A 1394 inter-connection cable shown in FIG. **50** has a physical shape in which a 1394 connector **5501** is connected to a half gateway **5503** by being connected through a relatively short dedicated 1394 cable **5502**. Also, a long Ethernet cable **5504** is connected from the half gateway **5503** in advance. This cable portion may be connected by an electric cable such as UTP5 or coaxial cable, or by an optical cable such as a plastic optical fiber. It should be noted however that the transmission scheme of the physical layer is supposed to obey the Ethernet standard. A connector **5505** at a free end of the long Ethernet cable **5504** is a connector in compliance with that physical layer transmission scheme.

This 1394 inter-connection cable is used by connecting the 1394 connector **5501** to a desired 1394 bus to be connected, and connecting the FANP Ethernet switch **5003** at the connector **5505** side. The FANP Ethernet switch **5003** may have a plurality of connector insertion ports.

As described above, the 1394 connector **5501** is connected to the half gateway **5503** through the relatively short dedicated 1394 cable **5502**, so that the power supply to the half gateway **5503** can be made through the 1394 connector **5501** and the 1394 cable **5502**. Consequently, the system of FIG. **50** requires no special power supply (although the power supply to the FANP Ethernet switch **5003** is basically necessary). From a viewpoint of a user who wishes to inter-connect two 1394 buses, this implies that the connection is basically completed by simply connecting one end (**5501**) of the cable to a desired 1394 bus to be connected and the other end (**5505**) of the cable to the FANP Ethernet switch **5003**, so that the convenience regarding the connecting operation can be improved remarkably.

Also, a long cable (such as that of several hundred meters, for example) can be used as a cable for connecting the half gateway **5503** and the FANP Ethernet switch **5003**, so that it is very useful in a case of connecting the 1394 buses which are far apart from each other.

It should be apparent that the above described 1394 inter-connection cable is not only applicable to a case of forming the connection between the 1394 half gateways as described above, but also to a case of realizing the usual 1394 bridge in the half bridge configuration. In that case, the function of the 1394 bridge can be realized by using the 1394 address instead of the IP address, similarly as in the second embodiment.

It is also to be noted that, in the second and third embodiments, the transmission scheme between the half gateways using the Ethernet has been described, but it is also possible to realize a case of using the other network such as token ring, FDDI, etc., without changing the above described mechanism.

Fourth Embodiment

The second and third embodiments are directed to a case of the transmission scheme using the Ethernet, in which the datalink layer forwarding to the next hop FANP node (that is, the data forwarding/data switching to the next hop node by referring only to the datalink layer header) is carried out by using the destination Ethernet address as a virtual connection ID on this Ethernet.

It is also possible to use the similar scheme in a case of using the ATM as the data transmission scheme between the half gateways. Here, however, unlike the case of using the Ethernet as the transmission scheme in which the destination Ethernet address is used as a virtual connection ID, the VPI/VCI of the ATM is to be used as a virtual connection ID.

FIG. **51** shows a case of connecting the half gateways by the ATM transmission scheme in the home network system similar to that of the second embodiment shown in FIG. **33**. Also, FIG. **52** shows an exemplary internal configuration of each of the half gateways **6002** and **6003** in FIG. **51**.

FIG. **51** and FIG. **52** differ from those of the second embodiment in that the connection between the half gateways **6002** and **6003** is realized by the ATM transmission scheme so that VPI/VCI value is used as the virtual connection ID, that an originally defined VPI/VCI value recognized by both of the half gateways is reserved as the default VC (the meaning of which is the same as in the first embodiment), and that there is no limit on a length of the ATM cable.

FIG. **53** shows a case of connecting the half gateways by the ATM transmission scheme in the home network system similar to that of the third embodiment shown in FIG. **45**. FIG. **53** differs from FIG. **45** in that a FANP ATM switch **6203** is provided instead of the FANP Ethernet switch **5003**. Also, FIG. **54** shows an exemplary internal configuration of the FANP ATM switch **6203** in FIG. **53**.

FIG. **53** and FIG. **54** differ from those of the third embodiment in that the connection between the half gateways **6202** and **6203** is realized by the ATM transmission scheme so that VPI/VCI value is used as the virtual connection ID, that an originally defined VPI/VCI value recognized by both of the half gateways is reserved as the default VC (the meaning of which is the same as in the first embodiment), and that there is no limit on a length of the ATM cable. In addition, an architecture of the FANP ATM switch **6203** is new.

Here, the default VC is terminated at the IP/FANP processing unit **6302** (see FIG. **54**), and cells will pass through an ATM switch **6303** before they reaches to the IP/FANP processing unit **6302**.

Consequently, in order to establish a direct datalink layer connection, that is an ATM connection, between ATM interface units **6301** and **6304**, the IP/FANP processing unit **6302** is required to have a function for making an appropriate setting for values of the header conversion table inside the ATM switch **6303**, and a function for directly connecting a specific ATM-VC of an ATM cable **6212** and a specific ATM-VC of an ATM cable **6213** at the ATM layer.

Note also that the realization of the connection between the half gateways according to the present invention encompasses not only the transmission schemes such as the Ethernet and ATM, but also the general connection-less and connection-oriented transmission schemes as well.

Fifth Embodiment

Next, with references to FIG. **55** to FIG. **57**, the fifth embodiment of the present invention will be described in detail.

This fifth embodiment is directed to a case of applying the scheme of the present invention as described above to the route setting and the bandwidth reservation using the MAC address.

FIG. **55** shows an exemplary overall configuration of a communication network system according to this fifth embodiment. As shown in FIG. **55**, this communication network system comprises a transmitting terminal **8001**, a first gateway **8002**, a second gateway **8003**, a third gateway **8004**, a receiving terminal **8005**, an ATM network **8011**, a first Ethernet **8012**, a second Ethernet **8013**, and a 1394 bus **8014**.

Here, it is assumed that the entire system constitutes a home network within the same home, similarly as in the first embodiment. Consequently, among the devices contained in this system, those which are the IP nodes are assumed to be belonging to the same IP subnet. Here, this IP subnet is assumed to have an IP subnet address N. However, unlike the second embodiment, two gateways (the second gateway **8003** and the third gateway **8004**) for connecting the first Ethernet, the second Ethernet and the 1394 bus are bridges, so that they may not necessarily have IP addresses (and they may not necessarily have IP processing units). The IP addresses of the nodes are assumed to be N. **1** for the transmitting terminal **8001**, N. **2** for the first gateway **8002**, and N. **3** for the receiving terminal **8005**. Also, the 1394 addresses and the Ethernet addresses of these nodes are as shown in FIG. **55**.

Here, the nodes (the third gateway **8004** and the receiving terminal **8005**) connected with the 1394 bus **8014** are also allocated with the MAC addresses. This can happen in several cases including the following.

(1) A case in which the 1394 bus **8014** is emulating the IEEE 802 type network such as the Ethernet.

(2) A case in which the MAC address is expressed by using a part of a region for the 1394 address.

Namely, this embodiment uses the expression scheme in which "a value of EUI**64** is expressed by the MAC address", for example. As such, it suffices to have a situation in which a node on the 1394 bus **8014** can be uniquely identified by using the MAC address.

Each of the transmitting terminal **8001**, the first gateway **8002**, the second gateway **8003**, the third gateway **8004** and the receiving terminal **8005** of this embodiment is the FANP node which has the extended FANP function of the present invention, but it differs from the FANP node of the first embodiment in that it is also capable of carrying out the route setting and the bandwidth (communication resource) reservation by using the MAC address rather than the IP address. This feature will now be described in detail.

The transmitting terminal **8001** has the same functions as the transmitting terminal **4001** of the second embodiment except that it is connected to the ATM network, so that its detailed description will be omitted here.

The first gateway **8002** is a FANP node for interconnecting the ATM network **8011** and the first Ethernet **8012**, which has the same functions as the half gateway (**4002**, **4003**) of the second embodiment except that it transmits or receives FANP control messages in terms of the MAC addresses with respect to the direction of the first Ethernet **8012**.

The second gateway **8003** inter-connects the Ethernets while the third gateway **8004** inter-connects the Ethernet and the 1394 bus, and they crucially differ from the first gateway **8002** in that they are capable of carrying out the route setting and the bandwidth reservation by the MAC addresses rather than the IP addresses. Namely, the second gateway **8003** and the third gateway **8004** are MAC address compatible FANP relay nodes.

Each of the second gateway **8003** and the third gateway **8004** is a learning bridge having a function for learning the MAC address, which functions to refer to an input address of an entered frame (Ethernet frame, 1394 asynchronous frame), and store it along an input port for a certain period of time.

The receiving terminal **8005** is the IP terminal as well, and has functions for exchanging IP packets with the transmitting terminal **8001**, and receiving video delivered from the transmitting terminal **8001**. It differs from the receiving terminal **4004** of the second embodiment in that this terminal also has a function for terminating the MAC address compatible FANP.

FIG. **56** shows an exemplary internal configuration of the third gateway **8004**. As shown in FIG. **56**, the third gateway **8004** comprises an Ethernet interface unit **8101**, a first MUX/DEMUX **8102**, an Ethernet/1394 transfer unit **8103**, a FANP processing unit **8104**, a second MUX/DEMUX **8105**, and an 1394 interface unit **8106**.

The Ethernet interface unit **8101** is an interface with respect to the physically connected Ethernet, and carries out the encapsulation and decapsulation of data to be exchanged with the first MUX/DEMUX **8102** and the Ethernet frames.

The first MUX/DEMUX **8102** has a function for referring to the protocol type field of the received Ethernet frame and

transferring this frame to the FANP processing unit **8104** if it is described as the FANP frame in the protocol type field, or to the Ethernet/1394 transfer unit **8103** otherwise.

The FANP processing unit **8014** has functions for carrying out the routing based on the MAC address, the FANP processing, etc., for the received FANP packets, by referring to a table of correspondence between the MAC address and the output port provided inside the Ethernet/1394 transfer unit **8103**.

The Ethernet/1394 transfer unit **8104** has a function for attaching a specific Ethernet header to data received from the 1394 side, especially data received through the isochronous channel, by using its isochronous channel number or the destination address with the specific register offset as a key, and transmitting it to the Ethernet side, and a function for transmitting data received from the Ethernet side to a specific isochronous channel or the destination address with the specific register offset on the 1394 side by using its header information as a key, as well as a function of the learning bridge for forwarding frames according to the destination addresses (MAC addresses) of the frames while constantly updating the internal table of correspondence between the MAC address and the output port. Namely, the data forwarding by this Ethernet/1394 transfer unit **8104** is carried out by the datalink layer processing alone. Also, the correspondence table formed here becomes identical to that of FIG. **35** or FIG. **36**.

The 1394 interface unit **8106** carries out the physical layer processing, the link layer processing, the bus management, and the transaction layer processing of the 1394 with respect to the connected 1394 bus, and the exchanges of data (PDU from a viewpoint of the 1394) with the FANP processing unit **8104** or the Ethernet/1394 transfer unit **8103** by passing the 1394 frames to be transmitted or received through the second MUX/DEMUX **8105**.

Note that the second MUX/DEMUX **8105** has a function for transferring the 1394 frame received from the 1394 interface unit **8106** to the FANP processing unit **8104** if an information indicating that it is the FANP frame is described in that 1394 frame.

Next, a case of transmitting video from the transmitting terminal **8001** to the receiving terminal **8005** will be described with reference to FIG. **57**.

First, the transmitting terminal **8001** transmits the ARP request packet to the ATM network **8011** in order to carry out the address resolution for ascertaining the datalink layer address of the receiving terminal **8005** from its IP address (step S**5701**). This ARP request is processed as the ATM-ARP within the ATM network **8011**.

This ARP request is forwarded to the first Ethernet **8012** by the first gateway **8002**. The first Ethernet **8012**, the second Ethernet **8013** and the 1394 bus **8014** are bridge connected so that this ARP request is broadcasted within these bridge connected networks and directly reaches to the receiving terminal **8005** (step S**5702**).

The receiving terminal **8005** makes the ARP response directly to the first gateway **8002**, and the first gateway **8002** makes the deputy ARP response to the transmitting terminal **8001**. At this point, the first gateway **8002** stores that the receiving terminal **8005** exists on the first Ethernet **8012** side (step S**5703** and step S**5704**).

Now, the transmitting terminal **8001** already recognizes that it is the FANP node itself and that what is to be transmitted from now on with respect to the receiving terminal **8005** is the video. Consequently, the transmitting terminal **8001** intends that the video to be transmitted from now on will be forwarded by the datalink processing alone without using the IP processing at the intermediate FANP nodes.

To this end, after the confirmation of the initial setting and the coding scheme using the IP packets and the confirmation of the video reception capability with respect to the receiving terminal **8005**, the transmitting terminal **8001** proceeds to the video transmission preparation.

First, the transmitting terminal **8001** carries out the ATM signaling so as to acquire an appropriate VC (step S**5705**). Then, the transmitting terminal **8001** carries out the FANP exchanges with respect to the first gateway **8002** through that VC. Here, the exchanges to be carried out are the same as in the first embodiment (step S**5706** to step S**5709**).

Now, the first gateway **8002** describes both the destination IP address and the destination MAC address in the propose message (step S**5710**).

The second gateway **8003** which is the receiving FANP node here is the FANP node compatible only with the MAC address, so that the second gateway **8003** refers to the MAC address field. Then, in order to notify that it is the FANP node compatible only with the MAC address, the second gateway **8003** returns the propose ACK message to the first gateway **8002** by describing only the MAC address (step S**5711**).

The first gateway **8002** that received this propose ACK message can ascertain that the downstream side FANP node wishes the FANP by the MAC address. Consequently, the first gateway **8002** transmits the offer message containing the destination MAC address to the second gateway **8003** which is the neighboring FANP node. This operation may be realized by setting the MAC address of the receiving terminal **8005** as the destination MAC address of the offer message, or by providing a new optional field in the FANP message (step S**5712**).

The second gateway **8003** takes the FANP message into the FANP processing unit by referring to the protocol type field of the Ethernet frame.

In this manner, the FANP processing is sequentially carried out up to the receiving terminal **8005** and the re-direct message is transmitted backwards sequentially, so as to complete the set up at each gateway. Finally, the transmitting terminal **8001** which received the re-direct message starts the video data transmission. By the above procedure, the reservation of the communication resource in the intermediate routes is carried out similarly as in the first to fourth embodiments, so that it becomes possible to realize the video data delivery while guaranteeing the communication quality.

Here, the At the first Ethernet **8012** and the second Ethernet **8013**, the dedicated MAC address for video may be acquired as in the second embodiment, but it is also possible to carry out the bandwidth reservation by directly using the original MAC address (M. **2** in this case). In such a case, at the first Ethernet **8012** and the second Ethernet **8013**, all the Ethernet frames with the MAC address destined to the receiving terminal **8005** described in the destination field will be frames for which the communication quality requested by the intermediate bridges (the second gateway **8003** and the third gateway **8004**) is guaranteed.

Namely, the present invention uses a mechanism which is capable of reserving the necessary communication quality for each destination MAC address, even in a simple bridge connection type network. Also, this mechanism is a very flexible one in that the routing control and the communication quality reservation as well as the corresponding datalink

layer control and connection can be realized end-to-end, in an environment in which the bridges and the routers, the IP address compatible FANP nodes, etc., are mixedly present (as in the first or fifth embodiment).

Note that the five embodiments described above are mainly directed to the control based on the IP address. However, it should be apparent that the present invention is equally applicable to any address system that can bundle all kinds of networks, such as E.164, Colba, JAVA and extended OLE.

Sixth Embodiment

Referring now to FIG. **58** to FIG. **67**, the sixth embodiment of the present invention will be described in detail.

FIG. **58** shows an exemplary overall configuration of a network system according to the sixth embodiment, for an exemplary case of taking data from a video server that is providing a video service into a home network through a public network such that the video service is received at a terminal connected to the home network.

As shown in FIG. **58**, this network system comprises a video server **7001**, a public network (Internet) **7004**, a connection device **7002**, a first home network (IEEE 1394) **7005**, a second home network **7006**, and a terminal **7003** connected to the first home network **7005**. Note that FIG. **58** shows an exemplary case of connecting only one terminal **7003** to the first home network **7005**, but it is possible to connect various types of terminals or inter-networking connection device and the like to both of the home networks **7005** and **7006** in practice.

The public network **7004** can be provided in various forms including CATV network, ISDN/B-ISDN network, ATM-PON network, high speed radio access network, ADSL/HDSL network, etc., but it is assumed in this sixth embodiment that the video service provides MPEG video data through Internet (MPEG-over-IP). Consequently, an interface through which this service is provided is assumed to be a digital interface.

In the following description, it is assumed that this digital network adopts ATM scheme as its datalink scheme, but the present invention is not limited to this particular case of using ATM scheme alone. For example, a datalink layer identifier such as VPI/VCI of ATM appearing in the following description corresponds to a B-channel identifier in the case of ISDN, or a frequency in the case of CATV. Thus the present invention encompasses those cases where VPI/VCI of ATM is replaced by any such other datalink layer identifier.

The video server **7001** can be a dedicated video server or a server that is capable of transmitting video signals such as a video handling WWW server for example. Here, "capable of transmitting video signals" does not necessarily implies a capability of real time transmission. For example, a case of delivering video data by best effort rather than real time delivery can be included.

The public network **7004** and the home networks **7005** and **7006** are connected at a dedicated connection device **7002**. In this case, the connection device **7002** has a function for terminating the public network **7004**, a function for terminating the home networks **7005** and **7006**, an IP processing function, a NAT (Network Address Translation) function which is standardized by RFC 1631, as well as an IP multicast handling function, an IP signaling function, a datalink layer level switch capable of realizing real time data transfer between the public network **7004** and the home networks **7005** and **7006**, and an address notification function, as will be described in detail below.

Next, IP subnet configuration and address assignment on the network system of FIG. **58** will be described. As shown in FIG. **58**, in this sixth embodiment, one IP subnet (with a network address P) is formed by the home networks as a whole (first and second home networks **7005** and **7006**), and in addition, private addresses standardized by RFC 1597 are utilized on the home networks. Also, a global IP address (G.2) is assigned to the public network side of the connection device **7002**.

The reason for adopting such an address configuration is that acquisition of a plurality of global IP addresses requires higher cost compared with acquisition of one global IP address and there is a worldwide shortage of IP addresses. Namely, it is practically almost impossible to assign new global IP addresses to connection terminals of home networks as a number of terminals and a number of addresses for home networks are expected to grow very rapidly.

Note that the first home network **7005** and the second home network **7006** may belong to different subnets provided that they use different private address systems. In such a case the connection device **7002** for inter-connecting them will be a router. In the following description, it is assumed that the first home network **7005** and the second home network **7006** belongs to the same subnet as described above.

FIG. **59** shows a processing sequence in a case of carrying out video transfer from the video server **7001** to the terminal **7003** through the connection device **7002** and the public network **7004**, while FIG. **60** shows a processing sequence of the terminal **7003** in that case and FIG. **61** shows a processing sequence of the connection device **7002** in that case.

As described in detail below, FIG. **59**, FIG. **60** and FIG. **61** are sequences in a case where the connection device **7002** is an SBM (Subnet Bandwidth Manager) and this mechanism is used for reservation of communication resource. Here, SBM is a unit for carrying out reservation of communication resource within subnet by using RSVP, which is discussed in the IntServ working group of IETF.

First, the terminal **7003** obtains information on a desired video using a protocol above layer **5** among seven layers standardized by OSI (steps **S7201**, **S7203**). This can be realized in various manners such as a negotiation using DSM-CC of MPEG/DAVIC or corresponding protocol, an information selection for selecting information from the WWW server on Web using RTSP, etc. In this sixth embodiment, these various manners are collectively referred to as an upper layer protocol, and it is assumed that the exchange of this information is realized by using IP packets.

Note here that this upper layer protocol may be communicated while being applied with NAT processing at the connection device **7002** (step **S7202**). Namely, in a case of forwarding an IP packet from a private IP network to Internet, it is not allowed to transmit a private IP address to Internet side, so that the connection device **7002** applies the NAT processing for translating a private IP address into a global IP address (G.2) of the connection device **7002** itself. For more detail of the NAT processing, see Japanese Patent Application No. 8-316552 (1996) for example.

In this sixth embodiment, the video service from the video server is assumed to be provided through IP multicast. In this case, when a video to be selected is determined using the upper layer protocol, there is a need to obtain an IP multicast address for transferring that video. There are several possible schemes that can be used for this broadcasting (delivery).

For example, there is a broadcasting scheme in which different IP multicast addresses are assigned to different videos (different video contents). This is a case of IP multicast address assignment in which a broadcast from a broadcast station A is assigned with an IP multicast address= “#1”, a broadcast from a broadcast station B is assigned with an IP multicast address=“#6” and so on, for example.

The video server **7001** notifies a multicast address “M” to be used for video transfer to the terminal **7003** through the upper layer protocol. Then, the terminal **7003** transmits a REPORT message for the multicast address “M” to be subscribed for, in response to a QUERY message received from Internet side, according to the IP multicast protocol (such as IGMP (Internet Group Management Protocol) (RFC 1112) for example) (step S**7204**).

Upon receiving this message, the connection device **7002** stores a correspondence between the private address “P.2” of the terminal **7003** and the requested multicast address “M” (step S**7205**), and notifies the REPORT message to the upstream side router (step S**7206**). At this point, the source address is set to be the global IP address “G.2” of the connection device **7002** itself. FIG. **62** shows an example of a correspondence table stored by the connection a device **7002**.

When the subscription for the multicast address “M” succeeds, the connection device **7002** stores the fact that the terminal **7003** has subscribed for the multicast address “M” (step S**7205**), and notifies this fact to the terminal **7003**.

Next, the terminal carries out the reservation of communication resource in order to receive this video in good quality. There are several possible methods that can be used for this communication resource reservation including:

(a) Method using SBM;

(b) Method using RSVP (Resource Reservation Setup Protocol); and

(c) Method using IEC 61663.

Note that SBM (Subnet Bandwidth Manager) is a scheme for reserving bandwidth within subnet which is proposed in IETF, the standardization organization for Internet, in which the bandwidth reservation within subnet is carried out by using RSVP. FIG. **59** shows an exemplary case of using SBM.

In this case, the connection device **7002** is an SBM node so that the routing protocol is not operating thereon. Note that the connection device **7002** of this embodiment has a NAT function so that it also has a global IP address (G.2), but even when there are plural physical interfaces on the home network side, there is no need for the connection device **7002** to have IP address (private address) for each physical interface separately. For example, it suffices for the connection device **7002** to have one private address in addition to the global IP address. In this embodiment, the connection device **7002** is assumed to have a private IP address “P.1”.

The terminal **7003** may urge the video server **7001** to transmit a PATH message of RSVP, by means of the upper layer protocol and the like. The PATH message will be transmitted with the multicast address “M” as destination, and arriving at the connection device **7002** (step S**7207**).

The connection device **7002** creates a PATH state of RSVP (step S**7208**), and transmits this PATH message with the multicast address “M” as destination so that it eventually arrives at the terminal **7003** (step S**7209**). Here, the connection device **7002** already recognizes that the terminal **7003** belongs to the multicast address “M” from the correspondence table of FIG. **62**, so that the connection device **7002** can forward this PATH message to the terminal **7003**.

In the connection device **7002**, the PATH state is created. Here the connection device **7002** is an SBM node. The terminal **7003** transmits an RESV message of RSVP to the connection device **7002** of the upstream side so as to reserve communication resource such as bandwidth (step S**7210**).

Upon receiving this RESV message, the connection device **7002** makes an access to an IEEE 1394 isochronous resource manager of the first home network (IEEE 1394) **7005** and reserves necessary bandwidth and isochronous channel number, so as to reserve communication resource between the connection device **7002** and the terminal **7003** (step S**7211**). An isochronous channel number reserved here is assumed to be “#x”.

At this point, the connection device **7002** may notify an information indicating ‘isochronous channel that should be used for transmitting the requested program’ to the terminal **7003** (step S**7212**).

There are several possible methods that can be used for this notification including the following.

The first notification method is a method using a PATH message of RSVP in a format shown in FIG. **63**. In this method, as shown in FIG. **63**, an information indicating that ‘hereafter (or now), data (IP flow) contained in this PATH message will be transmitted by an isochronous channel number=“#x”’ is described within the PATH message of RSVP.

The second notification method is a method using FANP (Flow Attribute Notification Protocol) as described in the first to fifth embodiments described above. Note that FANP notifies a correspondence between IP flow and the like (IP multicast address “M”, for example, in the case of this embodiment) to be transmitted and a link layer ID information (IEEE 1394 channel number reserved earlier in the case of this embodiment), among neighboring nodes (the connection device **7002** and the terminal **7003** in the case of this embodiment).

The third notification method is a method using CIP header of IEC 61663. In this method, the connection device **7002** directly writes a channel number to be used into a PCR (Plug Control Register) of the terminal **7003** by using IEC 61883, and makes the terminal **7003** recognize that the transmitted information is MPEG-over-IP by means of 1394 header or a CIP (Common Isochronous Packet) header defined by IEC 61663. For example, in a case of extending the CIP header, a value indicating that this packet is IP packet or MPEG-over-IP packet is written into an FMP (Format ID) region, such that it becomes possible for the terminal **7003** to recognize an attribute of that packet as IP packet or IP packet with MPEG mounted thereon by looking at the CIP header.

The fourth notification method is a method in which PCR is extended and the meaning of a part of PCR register is set to indicate contents to be transmitted through that channel number, as shown in FIG. **64**. For example, a value indicating that this packet is IP packet or MPEG-over-IP packet may be described. Alternatively, an attribute of flow to be transmitted through that channel number may be described, in a form of combination of source IP address, destination IP address, source port number, and a destination port number, for example. By providing such a register in the terminal **7003** and writing appropriate description into this register from the connection device **7002** (or controller), it becomes possible for the terminal **7003** to recognize that data to be received through that channel number is IP packet or MPEG-over-IP packet, or else an attribute of that data.

It should be apparent that any of the first to fourth notification methods described above may be used in suitable combination.

Note also that, as far as timing is concerned, apart from the timing described here, it is also possible to carry out the above described procedure at a stage where the reservation of communication resource up to the video server **7001** is completed so that the end-to-end communication becomes possible.

Now, when the reservation of communication resource on the downstream side has succeeded, the connection device **7002** passes the RESV message of RSVP to the further upstream side (step **S7213**).

Upon receiving this message, a router within Internet reserves communication resource of ATM network on the downstream side by using Q.2931 and the like, for example (step **S7214**), and after confirming this reservation, transmits the RESV message to the further upstream side. This operation is subsequently repeated by subsequent routers.

In addition, the router transmits an information on a datalink identifier (VPI/VCI in this case as the datalink technology employed is ATM) to be used to an RSVP/SBM node of the downstream direction by using PATH or FANP, so as to notify a correspondence between IP flow to be transmitted and datalink identifier to that RSVP/SBM node (step **S7215**). A VCI value of ATM reserved for the connection device **7002** is assumed to be "#y".

When the end-to-end communication resource is reserved in this manner, the video transfer is started (steps **S7216**, **S7217**).

Here, the connection device **7002** already recognizes that data of MPEG-over-IP are to be transmitted from the video server **7001** through an ATM connection "#y (VCI="#y"), and that it suffices to transmit received IP packets to the terminal **7003** through an isochronous channel "#x" of IEEE 1394.

Thus the connection device **7002** transmits data received through VCI "#y" directly to the isochronous channel "#x" of IEEE 1394 without verifying header contents of IP packets, by establishing synchronization among IP packets. Namely, the connection device **7002** can carry out a direct data transfer to 1394 by verifying only VCI value without applying any IP layer processing. This can be viewed as a datalink switch since switching of data is made according to datalink layer information alone.

As a consequence, an IP layer processing, that is a series of software processing such as IP header verification, routing processing, etc., that would have been required at the IP layer otherwise can be replaced by a datalink layer switching processing, so that it becomes possible to reduce a processing time and a processing load considerably. This corresponds to a provision of effectuating SBM and then effectuating datalink switch.

Note that the above description has been directed to a case where the connection device **7002** is as an SBM node, but it is also possible to carry out the reservation of communication resource using RSVP in a case where the connection device **7002** is a router.

It is also possible to carry out the above described reservation of communication resource by means of communication resource reservation using FANP as described in the first to fifth embodiment described above.

Up to here, a case where the communication resource reservation on IEEE 1394 is carried out by an upstream side node of RSVP has been described. In contrast, the reservation of an isochronous channel on IEEE 1394 bus may be carried out by a downstream side node (the terminal **7003** in the case of this embodiment), as indicated in FIG. **65**.

In FIG. **65**, after the downstream side node carries out the reservation of an isochronous channel having necessary communication resource (step **S7110**), an RESV message is transmitted to an upstream side (step **S7111**). The rest of FIG. **65** is substantially the same as FIG. **59**.

In this case, the reserved isochronous channel number and the like may be transmitted by including it in the RESV message of RSVP that is to be transmitted subsequently.

Also, the notification to the upstream side of a correspondence between an isochronous channel number and a flow for which bandwidth reservation is to be made may be realized by using a message other than the RESV message. Namely, the RESV message may be used simply for the purpose of requesting the bandwidth reservation for that flow with respect to the connection device **7002**, and the notification of the correspondence between an isochronous channel number and a flow for which bandwidth reservation Is to be made may be realized by using another message such as FANP message or by using PCR shown in FIG. **64**. Upon receiving this notification, the connection device **7002** can obtain from this message an information as to which link layer connection, that is isochronous channel, should be used for transferring a flow for which the bandwidth reservation has been made by the RESV message.

Now, when the user at the terminal **7003** wishes to watch a different video (a TV program on a different channel, for example), the above described procedure is going to be repeated once again. Namely, this can be realized by repeating a procedure of obtaining an IP multicast address corresponding to a new video through the upper level protocol and subscribing for that IP multicast address. At that time, it is preferable to secede from the previously subscribed IP multicast address from a viewpoint of efficient utilization of communication resource. FIG. **66** illustrates this process.

Also, when plural terminals are connected to the home network and these terminals are watching different programs, their respective data are going to pass through the public network **7004** and the connection device **7002**, and it is convenient from a viewpoint of the connection device **7002** to have these data with different destination terminals transmitted through different ATM-VCs because the datalink switching is to be carried out at the connection device **7002**. As for the reservation of communication resource, whether it is necessary to repeat the above described procedure using SBM, RSVP, FANP, etc. again or not depends on a manner of making reservation by RSVP/SBM. Namely, in a case of using Shared Explicit reservation, the same communication resource (VC of ATM, isochronous channel of 1394) as previously reserved can be used continually as long as the source video server is identical or as long as a new video server for transmitting a next video has been registered, and it suffices to make a subscription for IP multicast address again.

Next, a case of another broadcasting scheme in which contents can be changed while the same IP multicast address is used will be described. In this case, a plurality of video services are going to be carried out with respect to the same user using the same multicast address, and a video contents change (corresponding to a TV channel change) is going to be carried out by using the upper level protocol.

In this case, the same procedure as described above is also to be carried out up to the initial communication resource reservation. Here, however, the IP multicast address given through the upper layer protocol can be an IP multicast address uniquely given to that terminal in advance (IP multicast address assigned to each terminal or user by a network service provider in advance). The identification of the terminal can be realized by the upper layer protocol using an identifier assigned to each terminal by a network service provider in advance, for example.

At a time of next contents change (corresponding to TV channel change), the terminal requests this contents change by using the upper layer protocol. The video server **7001** continues to use the currently used IP multicast address without any change, and transmits the changed contents to that IP multicast address.

Similarly as described above, it is not absolutely necessary to use this IP multicast address for the purpose of multicast, and it is possible to use this IP multicast address for contents transfer with respect to a single terminal, as illustrated in FIG. **67**. Namely, one multicast address is assigned to one user (terminal) from which a video delivery request has been made, and a change of contents to be transmitted is handled by the upper layer protocol, for example.

It is also possible to trigger the judgement as to whether or not to assign different multicast addresses by looking at a difference in the port number of an IP packet transmitted from the connection device **7002**.

As such, by assigning different IP multicast addresses to different users or applications, it is possible to realize dynamic assignment of IP multicast addresses with respect to terminals and therefore it becomes possible to transmit various contents to the terminal having a private address, without worrying about an overlap with the globally unique IP address, even under the private address environment.

Note that the sixth embodiment has been described for an exemplary case of realizing transfer of IP multicast data flow by reserving bandwidth using RSVP, but it should be apparent that the scheme of this sixth embodiment is equally applicable to IP uni-cast as well as to a uni-cast or multicast at another network layer.

As described, according to this sixth embodiment, a scheme for applying RSVP to IEEE 1394 bus is specified in view of the conventionally encountered problem that a scheme for operating a network layer signaling protocol such as RSVP on IEEE 1394 has not been standardized and a straightforward mapping causes no guaranteed communication quality on IEEE 1394 and no guaranteed end-to-end communication quality, so that it becomes possible to realize communication that guarantees communication quality in an inter-connected network environment even on IEEE 1394.

Seventh Embodiment

Referring now to FIG. **68** to FIG. **83**, the seventh embodiment of the present invention will be described in detail.

FIG. **68** shows an exemplary overall configuration of a network system according to the seventh embodiment, in which an IGMP (Internet Group Management Protocol) router **7101**, an isochronous resource manager **7104** of IEEE 1394, and receiving terminals **7102** and **7103** are interconnected through an IEEE 1394 bus so as to enable communications among them.

(7-1)

Now, a case where the terminals **7102** and **7103** receive multicast data by subscribing for IP multicast in the network system of FIG. **68** will be described. Here, after subscribing for IP multicast, the terminals **7102** and **7103** become receiving terminals of multicast data so that these terminals will be referred to as receiving terminals **7102** and **7103**.

FIG. **69** shows a procedure by which the receiving terminals **7102** and **7103** subscribe for IP multicast, and FIG. **70** shows a processing procedure of the IGMP router **7101** in that procedure.

As shown in FIG. **68**, the IGMP router **7101**, the receiving terminals **7102** and **7103**, and the isochronous resource manager **7104** are connected on the IEEE 1394 bus. Here it is assumed that the receiving terminal **7102** has an IP address "IP1" and the receiving terminal **7103** has an IP address "IP2". Note that functions of the isochronous resource manager **7104** may be provided integrally within any of the other three elements of FIG. **68** (that is, any one of the IGMP router **7101** and the receiving terminals **7102** and **7103** may play a role of the isochronous resource manager). It is also assumed that the receiving terminals **7102** and **7103** already obtained an IP multicast address "IPm" in advance by some suitable means.

First, suppose that the receiving terminal **7102** is wishing to subscribe for the IP multicast address "IPm". To this end, an exchange of IGMP message (transmission and reception of IGMP QUERY, IGMP REPORT, etc.) is carried out between the IGMP router **7101** and the receiving terminal **7102**, such that the receiving terminal **7102** notifies that it is wishing to subscribe for the IP multicast address "IPm" to the IGMP router **7101** (step **S8101** of FIG. **69**). Here, the IGMP router **7101** is assumed to be a router capable of supporting this IP multicast address "IPm". This IGMP router **7101** may be something like a set-top box. Namely, the IGMP router **7101** may be a node having a function for extracting packets destined to the appropriate IP multicast address from IP multicast packets transmitted by broadcasts, and then forwarding the extracted packets.

Upon receiving a request of subscription for the IP multicast address "IPm" from the receiving terminal **7102**, the IGMP router **7101** executes the processing according to the flow chart of FIG. **70**. Namely, in this seventh embodiment, a subscription request from the receiving terminal **7102** is an initial subscription request for the IP multicast address "IPm" from its subnet (IEEE 1394 bus), so that the IGMP router **7101** carries out a prescribed processing procedure for subscription for IP multicast address (steps **S8201** to **S8203** of FIG. **70**). When this processing procedure is successfully completed, the IGMP router **7101** makes an access to the isochronous resource manager **7104** and reserves an isochronous channel number (steps **S8204** and **S8205** of FIG. **70**, step **S8102** of FIG. **69**). Note that, at the step **S8203** of FIG. **70**, the IGMP router **7101** may carry out the procedure for subscription for this IP multicast address by acting on another IGMP router on a further upstream side. When this processing procedure for subscription fails, the IGMP router **7101** notifies that fact to the receiving terminal **7102** (step **S8209** of FIG. **70**).

Here, the isochronous channel number reserved by the isochronous resource manager **7104** in response to a request from the IGMP router **7101** at the step **S8205** of FIG. **70** is assumed to be "#x". Note that it is not absolutely necessary to reserve bandwidth at this point because what is reserved at this point is an asynchronous stream of IEEE 1394. The asynchronous stream is a packet in an isochronous packet format which is to be transmitted at asynchronous arbitration time, for which only the isochronous channel number is reserved through the isochronous resource manager **7104**. A case where it is necessary to reserve bandwidth will be described later.

Returning now to FIG. **70**, when the isochronous channel number is reserved, the IGMP router **7101** writes an information on this IP multicast flow into own layer-**3** flow register (step **S8206** of FIG. **70**, step **S8103** of FIG. **69**).

FIG. **71** shows an exemplary format of the layer-**3** flow register. As shown in FIG. **71**, the layer-**3** flow register is basically a register for registering a correspondence between a layer-**2** ID (an isochronous channel number in the case of this seventh embodiment) and a layer-**3** flow that is going to pass through a channel indicated by that layer-**2** ID. In

addition to that, this register also have regions for registering an information as to whether that flow is to be inputted or outputted, an amount of bandwidth reserved for the channel indicated by that layer-**2** ID, a counter for counting a number of terminals that are using that channel, etc. As shown in FIG. **71**, no bandwidth is reserved for the reserved channel in this case, so that the bandwidth field of the layer-**3** flow register has a value "0" entered therein, for example.

The IP flow with the IP multicast address "IPm" as destination will be flowing into this channel so that, for the flow ID, "IPm" is entered as a destination IP address and a specified port number (PORT1 for example) when an available port number is limited or a value "0" when an available port number is not limited is entered as a destination port number. In the case of this seventh embodiment, an available port number is not limited so that a value "0" is entered into the destination port number. Also, the source terminal is not specified in a case of IP multicast address, so that a value "0" is entered as a source IP address and a source port number.

For the layer-**2** ID, "IEEE 1394" is entered as a layer-**2** type, "isochronous channel number is entered as an ID type, and the isochronous channel number "#x" that is reserved earlier is entered as an ID in this case.

As for direction, "output" is entered on an assumption that basically this IGMP router transmits these IP multicast packets.

The connection counter is a counter for indicating a number of nodes that can be regarded as receiving this asynchronous stream. The receiving terminal **7102** is a sole receiver at this point, so that a counter value "1" is entered into the connection counter.

Note that this layer-**3** flow register may be realized in a form of a combination of a plug control register used in IEC 61663 and a register for storing an information on the layer-**3** flow to be transferred through that channel.

Next, the IGMP router **7101** writes the same information as that of FIG. **71** into the layer-**3** flow register of the receiving terminal **7102**, except that the direction parameter is changed from "output" to "input" (step **S8207** of FIG. **70**, step **S8104** of FIG. **69**).

As the correspondence between the layer-**3** flow information and the layer-**2** ID is written into the layer-**3** flow register of the receiving terminal **7102** in this manner, it becomes possible for the receiving terminal **7102** to recognize hereafter that the channel number "#x" of the asynchronous stream is allocated for IP multicast with IP multicast address "IPm" as destination. Then, it suffices for the receiving terminal **7102** to receive the channel number "#x" of the asynchronous stream in order to receive datagrams destined to the IP multicast address "IPm" (step **S8105** of FIG. **69**).

Note that, in the above, the layer-**3** flow register of the receiving terminal **7102** also registers an information as to whether an IP flow coming from the asynchronous stream or the isochronous channel indicated by the channel number is to be inputted or outputted, but it is also possible to provide separate layer-**3** flow registers for input and output and use them properly.

Returning now to FIG. **69**, suppose that the receiving terminal **7103** is now wishing to subscribe for the same IP multicast address "IPm". Then, the processing procedure for subscription by the IGMP is carried out between the IGMP router **7101** and the receiving terminal **7103** (step **S8106** of FIG. **69**).

Then, the IGMP router **7101** carries out a processing shown in FIG. **70**. Namely, the IGMP router **7101** already started service for this IP multicast address "IPm" so that the IGMP router **7101** increments the connection counter of the own layer-**3** flow register is incremented (to a counter value "2", for example) (step **S8208** of FIG. **70**), and writes the same information as previously written into the layer-**3** flow register of the receiving terminal **7102** now into the layer-**3** flow register of the receiving terminal **7103** so as to notify the correspondence between the channel number and the IP flow (step **S8207** of FIG. **70**).

Note that a number of terminals subscribing for the IP multicast address "IPm" is comprehended by the IGMP router **7101** and it is not absolutely necessary for each terminal to comprehend this, so that the connection counter value written into the layer-**3** flow registers of the receiving terminals **7102** and **7103** may be a value "1" for example.

Up to here, a procedure for subscribing for IP multicast address has been described. Next, the operation of the IGMP router **7101** in a case of secession will be described with reference to FIG. **72**.

In the case of secession, when a procedure for secession from the IP multicast address "IPm" is received from either receiving terminal (step **S8301**), or when a keep alive signal IGMP REPORT indicating that receiving of the IP multicast address "IPm" is continuing from either receiving terminal is not received over a prescribed period of time (step **S8302**), the IGMP router **7101** Judges that this terminal wishes to stop receiving the IP multicast address "IPm", and decrements the connection counter value of the own layer-**3** flow register (step **S8303**).

The connection counter value written in the layer-**3** flow register of the IGMP router **7101** indicates a number of terminals subscribing for the IP multicast address "IPm" on that IEEE 1394 bus, so that when this value becomes "0" (step **S8304**), the IGMP router **7101** Judges that there is no terminal which is receiving the IP multicast address "IPm" on that IEEE 1394 bus, and secedes from that IP multicast address "IPm" (step **S8305**).

In parallel to this, in order to notify the secession to the seceded terminal, the IGMP router **7101** may carry out an operation to write all "**0**" values, for example, into the layer-**3** flow register of the seceded terminal.

Note that by maintaining the information on the IP multicast address as well as values of the layer-**3** flow register even when a bus reset is caused in the IEEE 1394 bus in a course of IP multicast address subscription or a series of processing after the subscription, it becomes possible to realize a quick recovery of the IP multicast datagram receiving.

Note also that all packets destined to the IP multicast address "IPm" are going to be transmitted and received through the asynchronous stream indicated by the channel number "#x". Here, control packets of IGMP and the like may be communicated by using the asynchronous stream corresponding to that multicast address, default asynchronous stream (ARP (Address Resolution Protocol)), or asynchronous stream channel or asynchronous broadcast allocated for the purpose of IP broadcast or the like.

Also, either default asynchronous stream or asynchronous write broadcast is to be used as a channel for transmitting control packets of IGMP and IP packets and the like with a destination address indicating all hosts such as IP address= "224. 0. 0. 1" for example, at a time of IP multicast subscription.

(7-2)

Next, a case of changing IP multicast into a state of "using bandwidth (QOS)", that is, a case of assigning bandwidth to the asynchronous stream and using it for transmission and reception, will be described with reference to FIG. **73**.

Up to a point where the receiving terminal **7102** becomes capable of receiving datagrams destined to the IP multicast address "IPm" (steps **S8501** to **S8504**), the procedure is the same as the steps **S8101** to **S8105** of FIG. **69** described above.

When a transmission using bandwidth is possible for this IP multicast, the IGMP router **7101** sends a PATH message of RSVP to the receiving terminal (the IP multicast address "IPm") (step **S8505**).

In response, the receiving terminal **7102** which wishes to receive this IP multicast in a state of "using bandwidth" sends an RESV message of RSVP to the upstream side (i.e., the IGMP router **7101**) so as to request a reservation of bandwidth (step **S8506**).

In RSVP which is an example of bandwidth reservation protocols on IP, a transmitting host (an upstream side node) transmits a PATH message along with data. Communication bandwidth and the like are basically set up by this transmitting host. In contrast, the receiving terminal which wishes to make bandwidth reservation transmits an RESV message with the transmitting node as destination. In general, a router monitors the RESV message corresponding to the PATH message, and executes the bandwidth reservation when the RESV message is detected. Here it is assumed that the above described correspondence between the IP multicast address and the channel is already set up.

When the RESV message from the receiving terminal **7102** is detected, the IGMP router **7101** makes an access to the isochronous resource manager **7104** and reserves bandwidth. When the bandwidth is successfully reserved, an information on reserved bandwidth (an amount of bandwidth y) is entered into the layer-**3** flow registers of its own and the receiving terminal **7101**, so as to notify the success of bandwidth reservation (steps **S8507** and **S8508**).

Thereafter, transfer of datagram destined to the IP multicast address "IPm" is continued using the isochronous channel (channel number "#x") for which bandwidth is reserved (step **S8509**).

Note that, when there are plural receiving terminals at this point, the IGMP router **7101** may rewrite a bandwidth portion of the layer-**3** flow register of each receiving terminal. It is also possible to adopt a scheme in which the rewriting of the layer-**3** flow register of the receiving terminal is not carried out as it becomes tedious when there are many receiving terminals, and the rewriting is carried out only in the layer-**3** flow register of its own (IGMP router **7101**).

As described, in a case of assigning bandwidth to the asynchronous stream, it is possible to avoid the so called double reservation of bandwidth in which plural receiving terminals reserve bandwidth for the same channel at the same time, by following the rule that the reservation of bandwidth is carried out by a node that transmits QOS packets. Moreover, it is expected that the transmitting node is usually comprehending a value of necessary bandwidth in most cases so that this rule is appropriate in view of this fact as well.

(7-3)

Now, in the above, the correspondence between the IP multicast flow and the channel number of isochronous channel or asynchronous stream through which that flow passes has been notified by using the layer-**3** flow register, but it is also possible to realize this notification by using FANP. Note that FANP is a protocol for notifying a correspondence between some datalink layer channel (such as isochronous channel or asynchronous stream of IEEE 1394 or virtual channel of ATM or frame relay, etc.) and an upper layer flow (such as IP flow) that pass through that channel, by using IP datagrams.

FIG. **74** shows a processing procedure in this case. When the receiving terminal **7102** wishes to subscribe for the IP multicast address "IPm", the subscription procedure using IGMP is carried out similarly as in the case of FIG. **69** between the receiving terminal **7102** and the IGMP router **7101** (step **S8601**). The IGMP router **7101** then makes an access to the isochronous resource manager **7104** in order to reserve a channel for this IP multicast address "IPm", and reserves the channel number "#x" (step **S8602**).

Next, the IGMP router **7101** uses the plug control register of IEEE 1394 and FANP in order to notify that 'IP multicast "IPm" will be offered through channel "#x"' to the receiving terminal **7102**.

The plug control register is a register that has an effect of urging reception or transmission of isochronous channel/asynchronous stream provided by using some channel number, and the plug control registers for input and output are provided separately. Using this plug control register, the IGMP router **7101** urges the receiving terminal **7102** to receive the channel "#x" (step **S8603**). Note that, at this point, the IGMP router **7101** may carry out writing into the own plug control register as well. In such a case, a number of receiving terminals of that IP multicast address can be entered into the connection counter according to the same rule as described above. By means of this, it becomes possible to comprehend a number of nodes that are receiving that multicast from that channel.

Next, the IGMP router **7101** sends a message as shown in FIG. **75** as a FANP OFFER message to the receiving terminal **7102**. This FANP message has the IP multicast address "IPm" as destination, and sent through a broadcast channel for layer-**3** packets allocated to IEEE 1394 bus (packets of a specific asynchronous stream or packets with node ID=all "1" as destination, for example).

As shown in FIG. **75**, the FANP OFFER message contains a flow ID and a layer-**2** ID, and notifies a correspondence between the above described layer-**2** ID (channel number "#x" in the case of this embodiment) and an upper layer flow provided through a channel indicated by this layer-**2** ID (IP multicast address "IPm" in the case of this embodiment) (step **S8604**).

Thereafter, transmission of datagrams destined to the IP multicast address "IPm" is carried out through this channel "#x" (step **S8605**).

Similarly, when there is a subscription request from the other receiving terminal **7103** (step **S8606**), the notification of the correspondence can be realized by carrying out the writing into the plug control register (step **S8607**) and the sending of the FANP message (step **S8608**).

Note that the FANP message in this case is destined to the IP multicast address so that even when there are plural receiving terminals it is not absolutely necessary to send the FANP message to each one of the receiving terminals one by one, and it suffices to transmit the datagram destined to the IP multicast address "IPm" Just once, so that it is advantageous from a viewpoint of reduction of traffic on IEEE 1394 bus.

Now, in this embodiment, the correspondence between the layer-**2** ID and the layer-**3** flow has been notified by using the plug control register and the FANP OFFER message. Here, the notification of the above described correspondence cannot be realized unless the FANP message is used, but the receiving terminal can be made to carry out reception of data from this isochronous channel by writing into the plug control register, so that when it is not absolutely necessary

to notify the above described correspondence, the above described sending of the FANP message may be omitted. Conversely, when there is a FANP message, it becomes possible for the receiving terminal to recognize which layer-**3** flow is going to be inputted from which channel number, so that the above described writing into the plug control register may be omitted if desired.

(7-4)

Next, a processing procedure in a case where a plurality of flows are to be transmitted by using the same IP multicast address will be described with reference to FIG. **76**.

FIG. **76** shows a case of transmitting multicast packets with the IP multicast address "IPm" from the IGMP router **7101** to the receiving terminal **7102**, where two flows including a flow indicated by the port number "PORT1" (step S**8804**) and a flow indicated by the port number "PORT2" (step S**8805**) are to be transmitted simultaneously.

The subscription for multicast address by IGMP (step S**8801**) and the reservation of isochronous channel number by the IGMP router **7101** (step S**8802**) are the same as described above.

At a time of carrying out the writing into the layer-**3** flow register at the step S**8803**, a flow to be transmitted by the asynchronous stream indicated by the isochronous channel number "#x" reserved at the step S**8802** is not particularly specified, and only the fact that packets of the IP multicast address "IPm" are going to be transmitted is specified, so that both flows of the steps S**8804** and S**8805** are going to be transmitted by the asynchronous stream indicated by the channel number "#x".

Now, suppose that the IGMP router **7101** permits transmission using QOS for a flow represented by "PORT1" among these two flows. For this reason, the IGMP router **7101** sends a PATH message of RSVP with the IP multicast address "IPm" as destination (step S**8806**). In response, the receiving terminal **7102** sends an RESV message so as to request bandwidth reservation (step S**8807**). Then, the IGMP router **7101** makes an access to the isochronous resource manager **7104** and reserves necessary bandwidth specified by the RESV message. Here, the reserved amount of bandwidth is assumed to be "y" (step S**8808**).

Then, the IGMP router **7101** carries out the writing into the layer-**3** flow register of the receiving terminal **7102** in order to notify the receiving terminal **7102** that data with the amount of bandwidth "y" are going to be transmitted through the isochronous channel number "#x" at arbitration period of the isochronous channel (step S**8809**). At this step S**8809**, the notification to the receiving terminal **7102** is not necessarily limited to the above described case of using the layer-**3** flow register, and it is also possible to realize this notification by using FANP or plug control register of IEC 61663 as described above. Which scheme is to be adopted depends on requirements of the system.

Subsequently IP multicast data from the IGMP router **7101** are transmitted through the asynchronous stream for the flow represented by "PORT2" for which bandwidth is not reserved (step S**8811**), similarly as in the case of the step S**8805**, and through the isochronous channel (at arbitration period of the isochronous channel) for the flow represented by "PORT1" for which bandwidth is reserved (step S**8810**).

Now, at the IGMP router **7101**, there is a possibility for introducing IP multicast data (IP multicast packets destined to "IPm") with bandwidth greater than the amount of bandwidth "y" reserved for the isochronous channel "#x". However, it is not preferable to let these packets flow through the isochronous channel "#x" as they are because these IP multicast packets would additionally consume as much communication resource as bandwidth which has not been reserved.

For this reason, it is possible to use an algorithm shown in FIG. **77** which establishes a rule that a part for which bandwidth has been reserved is to be transmitted through the isochronous channel (steps S**2901** and S**2902**) while a part for which bandwidth has not been reserved is to be transmitted through the asynchronous stream (step S**2901** and S**2903**), so as to prevent the IGMP router **7101** to let those data with an amount of bandwidth greater than reserved one flow through the isochronous channel. In FIG. **77**, "T-spec" refers to a traffic parameter specified at a time of reservation by RSVP, and it is also possible to specify a peak rate, a depth of bucket in the leaky bucket, etc.

FIG. **78** shows an exemplary configuration for realizing the mechanism of FIG. **77**. Here, WFQ stands for Weighted Fair Queueing, which is a packet scheduling scheme in which a ratio of amounts of packets to be transmitted for respective flows is set equal to a ratio of values (called weights) specified for respective flows in advance, in a case where one output port is to be shared by a plurality of packets from a plurality of senders/flows.

In FIG. **78**, a WFQ processing unit **7201** enters a packet which satisfies the T-spec into an isochronous queue **7202** and a packet which does not satisfy the T-spec into an asynchronous queue **7203** according to this WFQ scheduling, and data queued in the isochronous queue **7202** are transmitted at isochronous arbitration period via a packet transmission unit **7204** while data queued in the asynchronous queue **7203** are transmitted at asynchronous arbitration period via the packet transmission unit **7204**.

In the above, a scheme for using the same value for the isochronous channel number continually even when bandwidth is reserved has been described. In contrast, it is also possible to adopt a scheme which reserves another isochronous channel ("#z") different from the isochronous channel ("#x") used for the asynchronous stream, with respect to a channel for which bandwidth reservation is necessary.

A processing procedure for this case will now be described with reference to FIG. **79**.

In FIG. **79**, the steps S**9101** to S**9107** up to a point where a request (RESV) for bandwidth reservation from the receiving terminal **7101** is received by using RESV message of RSVP are the same as the steps S**8801** to **8807** of FIG. **76**.

When the bandwidth reservation request is received at the step S**9107**, the IGMP router **7101** reserves an isochronous channel number "#z" different from the channel number "#x" of the asynchronous stream used up until then and an amount of bandwidth "y" (steps S**9108** and S**9019**). This case also obeys the rule that "a sender (that is, the IGMP router **7101** in the case of this embodiment) reserves necessary link layer bandwidth".

Then, the IGMP router **7101** writes that a flow represented by "PORT1" will be transmitted through an isochronous channel (rather than asynchronous stream) indicated by the isochronous channel number "#z", into the layer-**3** flow register of the receiving terminal **7102**, so as to notify the receiving terminal **7102** (step S**9110**). Note that, at the step S**9111**, the notification to the receiving terminal **7102** is not necessarily limited to the above described case of using the layer-**3** flow register, and it is also possible to realize this notification by using FANP or plug control register of IEC 61663 as described above.

Thereafter, among the packets destined to the IP multicast address "IPm", a flow represented by "PORT1" is transmitted by the isochronous channel with the isochronous channel number "#z" (step S**9111**) while the other flows continue to be transmitted by the asynchronous stream (step S**9112**).

(7-5)

Next, a case of handling plural senders of multicast data using asynchronous stream or isochronous channel indicated by one channel number will be described with reference to FIG. **80**. Here, after subscribing for IP multicast, the terminals **7102** and **7103** of FIG. **68** become transmitting and receiving terminals of multicast data, and these terminals will be referred to as terminals A and B in the following.

FIG. **80** shows a case where two terminals including the terminal A (IP address "IP**1**", 1394 address "FW**1**") and the terminal B (IP address "IP**2**", 1394 address "FW**2**") are transmitting IP multicast packets with respect to the same IP multicast address "IPm". Here, the 1394 address indicates an ID by which each terminal can be uniquely identified on that IEEE 1394 bus, such as a node ID of IEEE 1394, for example.

In FIG. **80**, the steps S**9201** to S**9204** and S**9206** to S**9208** for the subscription for multicast, the reservation of channel number, and the notification of the correspondence between the IP multicast address and the channel number are the same as those in FIG. **69**.

What is characteristic in FIG. **80** is that each of the terminals A and B transmits an IP multicast packet by attaching an own source address ("FW**1**" or "FW**2**") through the channel indicated by the same channel number "#x" (step S**9205**, S**9209** and S**9210**). This source address is written into a header called fragment header, which is a header given to each fragmented piece at a time of fragmenting an IP packet into 1394 frames.

FIGS. **81**A and **81**B show exemplary configuration of IP multicast data transmitted from the terminals A and B, respectively. As shown in FIGS. **81**A and **81**B, these IP multicast data are formed by encapsulating an IP multicast packet (or its fragment) **7301** or **7304** by using a fragment header containing the source address to yield fragment data **7302** or **7305**, and then housing this fragment data **7302** or **7305** inside a 1394 frame **7303** or **7306** (which is an isochronous frame in this case).

The receiver is going to receive packets from a plurality of senders out of the asynchronous stream indicated by the same channel number, but as the source address is attached to each frame as described above, it is still possible for the receiver to re-assemble each packet accurately by referring to the source address.

Up to here, a case of transmitting IP multicast packets from plural senders with respect to the same IP multicast address without using bandwidth reservation has been described. Now, a case of transmitting IP multicast packets from plural senders with respect to the same IP multicast address while using bandwidth reservation will be described with reference to FIG. **82**.

In FIG. **82**, it is assumed that the IP multicast packets destined to the same IP multicast address "IPm" are transmitted from two senders, i.e., the terminals A and B, in a form of asynchronous stream, as a result of completing a procedure of steps S**9201** to S**9210** of FIG. **80**, for example (steps S**9401** and S**9402**).

Here, when the terminal A is requested to transmit IP multicast data in a form of using bandwidth in some way (as in a case where RESV of RSVP is received, for example), or when the terminal A itself selects to transmit data in a form of using bandwidth, the terminal A makes an access to the isochronous resource manager **7104** to reserve a desired amount of bandwidth (y**1**) (step S**9403**), and thereafter the terminal A transmits IP multicast packets through the isochronous channel with the reserved amount of bandwidth y**1** at the isochronous arbitration period (step S**9404**). Here, the terminal B that has not reserved bandwidth continues to transmit IP multicast packets by the same channel number "#x", but as the asynchronous stream at the asynchronous arbitration period (step S**9405**).

In a case where the terminal B also transmits IP multicast packets in a form of using bandwidth, the terminal B also makes an access to the isochronous resource manager **7104** to reserve a desired amount of bandwidth (y**2**) (step S**9406**), and transmits IP multicast packets through the isochronous channel with the reserved amount of bandwidth y**2** at the isochronous arbitration period (step S**9408**).

In a case of cancelling the previously reserved bandwidth, a request for cancellation of that bandwidth is made with respect to the isochronous resource manager **7104** (step S**9409**) and packet transmission at the isochronous arbitration period is stopped. If there is a packet to be transmitted, this packet is transmitted by the asynchronous stream (at the asynchronous arbitration period) (step S**9410**).

On the other hand, in a case of transmitting IP multicast in a form of using bandwidth, it is also possible to adopt a scheme which transmits IP multicast packets through an isochronous channel with a channel number "#z" which is different from a channel number "#x" used by the asynchronous stream. A processing procedure in this case will now be described with reference to FIG. **83**.

In FIG. **83**, it is assumed that the IP multicast packets destined to the same IP multicast address "IPm" are transmitted from two senders, i.e., the terminals A and B, in a form of asynchronous stream, as a result of completing a procedure of steps S**9201** to S**9210** of FIG. **80**, for example (steps S**9501** and S**9502**).

Here, when the terminal A is requested to transmit IP multicast data in a form of using bandwidth by means of RESV message of RSVP and the like (as in a case shown in FIG. **83** where an RESV message of RSVP is received from the terminal B in response to a PATH message of RSVP from the terminal A, for example), the terminal A makes an access to the isochronous resource manager **7104** to reserve an isochronous channel number "#z" and a desired amount of bandwidth (y**1**) (steps S**9503** to S**9506**).

Then, the terminal A transmits a FANP message for notifying the correspondence between the reserved isochronous channel number and a flow to be transmitted through that isochronous channel, to that IP multicast address "IPm" through the asynchronous stream "#x" or a default asynchronous stream, for example (step S**9507**). A node which received this FANP message becomes possible to recognize which flow is going to be inputted in what characteristic from which isochronous channel. Note that, as described above, the notification of the correspondence is realized by using the FANP message here but it is also possible to realize this notification by using the layer-**3** flow register or the plug control register of IEC 61663.

As described, according to this seventh embodiment, it becomes possible to carry out IP multicast by utilizing communication resource efficiently, and to enable recognition of correspondence between reserved channel and IP multicast address at a transmitting side and a receiving side in synchronization, in a network of broadcast type such as IEEE 1394.

Note also that the present invention has been described above with the current Internet (i.e. IPv4) in mind, but it should be apparent that the present invention is equally valid in the next generation Internet (i.e. IPv6).

As described, when a network is formed by connecting the communication terminal devices, relay devices, IEEE 1394 inter-connection cable according to the present invention, it becomes possible to realize a large scale and

multifarious (i.e. capable of using various networks) implementation of the home network containing the 1394 bus. Moreover, this scheme has a great affinity with the public network and the Internet.

It is to be noted that, besides those already mentioned above, many modifications and variations of the above embodiments may be made without departing from the novel and advantageous features of the present invention. Accordingly, all such modifications and variations are intended to be included within the scope of the appended claims.

What is claimed is:

1. A data transmitting node connected with a physical network, comprising:

a first transmission unit for transmitting a control message in a case of transmitting information data to a receiving node connected with the physical network or another physical network, the control message including an IP (Internet Protocol) address information of a data transmission destination, a header or channel information dependent on the physical network, and a layer indication information indicating that the information data to be transmitted according to the header or channel information is data in an upper layer of an IP layer; and

a second transmission unit for transmitting the information data to the receiving node, the information data containing the header or channel information and data of the upper layer without IP packet encapsulation.

2. The data transmitting node of claim **1**, wherein the control message commands to a network inter-connection node for connecting said physical network and a next physical network a registration of a correspondence between the header or channel information dependent on said physical network and a header or channel information dependent on the next physical network.

3. The data transmitting node of claim **1**, further comprising:

a reception unit for receiving digital video and/or digital audio data;

wherein the second transmission unit transmits the digital video and/or digital audio data received by the reception unit as the information data, by formatting the digital video and/or digital audio data into a transmission format for said physical network.

4. A network inter-connection node for transmitting information data received from one physical network to another physical network, comprising:

a reception unit for receiving a first control message from said one physical network, the first control message containing an IP (Internet Protocol) address information of a data transmission destination, a first header or channel information dependent on said one physical network, and a layer indication information indicating that an information data to be transmitted according to the first header or channel information is data in an upper layer of a protocol layer corresponding to the IP address information;

a first transmission unit for transmitting a second control message to said another physical network when the reception unit receives the first control message, the second control message containing the IP address information, a second header or channel information dependent on said another physical network which is obtained from the IP address information, and the layer indication information indicating that the information data to be transmitted according to the second header or channel information is data in the upper layer;

a memory unit for storing a correspondence between the first header or channel information and the second header or channel information; and

a second transmission unit for obtaining the second header or channel information corresponding to the first header or channel information according to the correspondence stored in the memory unit when the information data containing the first header or channel information is received from said one physical network, attaching the second header or channel information to the information data, and transmitting the information data to said another physical network, the information data containing data of the upper layer without IP packet encapsulation.

5. The network inter-connection node of claim **4**, wherein the first control message commands a registration of a correspondence between the first header or channel information and the second header or channel information, and

the second control message commands to a receiving node or a network inter-connection node for connecting said another physical network and a third physical network a registration of a correspondence between the second header or channel information and a header or channel information dependent on said third physical network.

6. A data transmitting node connected with a physical network, comprising:

a first transmission unit for transmitting a control message in a case of transmitting information data to a receiving node connected with the physical network or another physical network, the control message including an IP (Internet Protocol) address information of a data transmission destination, a header or channel information dependent on the physical network, and an information indicating a required communication resource; and

a second transmission unit for transmitting the information data containing the header or channel information for which the required communication resource is reserved, to the receiving node,

wherein the control message commands to a network inter-connection node for connecting said physical network and a next physical network a registration of a correspondence between the header or channel information dependent on said physical network and a header or channel information dependent on the next physical network for which the required communication resource is reserved.

7. A network inter-connection node for transmitting information data received from one physical network to another physical network, comprising:

a reception unit for receiving a first control message from said one physical network, the first control message containing an IP (Internet Protocol) address information of a data transmission destination, a first header or channel information dependent on said one physical network, and an information indicating a required communication resource;

a first transmission unit for transmitting a second control message to said another physical network when the reception unit receives the first control message, the second control message containing a second header or channel information dependent on said another physical network which is obtained from the IP address information, and the information indicating the required communication resource;

an establishing unit for establishing a communication path with respect to a receiving node or a next network

inter-connection node for connecting said another physical network and a third physical network, the communication path having the second header or channel information with the required communication resource;

a memory unit for storing a correspondence between the first header or channel information and the second header or channel information; and

a second transmission unit for obtaining the second header or channel information corresponding to the first header or channel information according to the correspondence stored in the memory unit when the information data containing the first header or channel information is received from said one physical network, attaching the second header or channel information to the information data, and transmitting the information data to said another physical network.

8. The network inter-connection node of claim **7**, wherein the first control message commands a registration of a correspondence between the first header or channel information and the second header or channel information, and

the second control message commands to the receiving node or the next network inter-connection node a registration of a correspondence between the second header or channel information and a header or channel information dependent on said third physical network.

9. A data transmitting node connected with a physical network, comprising:

a first transmission unit for transmitting a control message in a case of transmitting information data to a receiving node connected with the physical network or another physical network, the control message including an IP (Internet Protocol) address information of a data transmission destination, a header or channel information dependent on the physical network, and an information on a format of the information data to be transmitted according to the header or channel information; and

a second transmission unit for transmitting the information data in said format which contains the header or channel information, to the receiving node,

wherein the control message commands to a network inter-connection node for connecting said physical network and a next physical network a registration of a correspondence between the header or channel information dependent on said physical network and the header or channel information dependent on the next physical network.

10. A network inter-connection node for transmitting information data received from one physical network to another physical network, comprising:

a reception unit for receiving a first control message from said one physical network, the first control message containing an address information of a data transmission destination, a first header or channel information dependent on said one physical network, and an information on a format of the information data to be transmitted according to the first header or channel information;

a first transmission unit for transmitting a second control message to said another physical network when the reception unit receives the first control message, the second control message containing the address information, a second header or channel information dependent on said another physical network which is obtained from the address information, and the information on a format of the information data to be transmitted according to the second header or channel information;

a memory unit for storing a correspondence between the first header or channel information and the second header or channel information;

a conversion unit for converting a transmission format of the information data to be transmitted from a transmission format in the said one physical network to a transmission format in said another physical network; and a second transmission unit for obtaining the second header or channel information corresponding to the first header or channel information according to the correspondence stored in the memory unit when the information data containing the first header or channel information is received from said one physical network, attaching the second header or channel information to the information data, and transmitting the information data to said another physical network.

11. The network inter-connection node of claim **10**, wherein the first control message commands a registration of a correspondence between the first header or channel information and the second header or channel information, and

the second control message commands to a receiving node or a network inter-connection node for connecting said another physical network and a third physical network a registration of a correspondence between the second header or channel information and a header or channel information dependent on said third physical network.

12. The network inter-connection node of claim **10**, wherein the information data to be transmitted by the second transmission unit is MPEG data, and the conversion unit converts the transmission format of the MPEG data from a transmission format for the MPEG data in said one physical network to a transmission format for the MPEG data in said another physical network.

13. A method of data transmission at a data transmitting node connected with a physical network, comprising the steps of:

(a) transmitting a control message in a case of transmitting information data to a receiving node connected with the physical network or another physical network, the control message including an IP (Internet Protocol) address information of a data transmission destination, a header or channel information dependent on the physical network, and a layer indication information indicating that the information data to be transmitted according to the header or channel information is data in an upper layer of an IP layer; and

(b) transmitting the information data to the receiving node, the information data containing the header or channel information and data of the upper without IP packet encapsulation.

14. The method of claim **13**, wherein the control message commands to a network inter-connection node for connecting said physical network and a next physical network a registration of a correspondence between the header or channel information dependent on said physical network and a header or channel information dependent on the next physical network.

15. The method of claim **13**, further comprising the step of:

(c) receiving digital video and/or digital audio data;

wherein the step (b) transmits the digital video and/or digital audio data received by the step (c) as the information data, by formatting the digital video and/or digital audio data into a transmission format for said physical network.

16. A method of data transmission at a network inter-connection node for transmitting information data received from one physical network to another physical network, comprising the steps of:

(a) receiving a first control message from said one physical network, the first control message containing an IP (Internet Protocol) address information of a data transmission destination, a first header or channel information dependent on said one physical network, and an information indicating that a layer indication information data to be transmitted according to the first header or channel information is data in an upper layer of a protocol layer corresponding to the IP address information;

(b) transmitting a second control message to said another physical network when the step (a) receives the first control message, the second control message containing the IP address information, a second header or channel information dependent on said another physical network which is obtained from the IP address information, and the layer indication information indicating that the information data to be transmitted according to the second header or channel information is data in the upper layer;

(c) storing a correspondence between the first header or channel information and the second header or channel information; and

(d) obtaining the second header or channel information corresponding to the first header or channel information according to the correspondence stored by the step (c) when the information data containing the first header or channel information is received from said one physical network, attaching the second header or channel information to the information data, and transmitting the information data to said another physical network, the information data containing data of the upper layer without IP packet encapsulation.

17. The method of claim 16, wherein the first control message commands a registration of a correspondence between the first header or channel information and the second header or channel information, and

the second control message commands to a receiving node or a network inter-connection node for connecting said another physical network and a third physical network a registration of a correspondence between the second header or channel information and a header or channel information dependent on said third physical network.

18. A method of data transmission at a data transmitting node connected with a physical network, comprising the steps of:

(a) transmitting a control message in a case of transmitting information data to a receiving node connected with the physical network or another physical network, the control message including an IP (Internet Protocol) address information of a data transmission destination, a header or channel information dependent on the physical network, and an information indicating a required communication resource; and

(b) transmitting the information data containing the header or channel information for which the required communication resource is reserved, to the receiving node;

wherein the control message commands to a network inter-connection node for connecting said physical network and a next physical network a registration of a correspondence between the header or channel information dependent on said physical network and a header or channel information dependent on the next physical network for which the required communication resource is reserved.

19. A method of data transmission at a network inter-connection node for transmitting information data received from one physical network to another physical network, comprising the steps of:

(a) receiving a first control message from said one physical network, the first control message containing an IP (Internet Protocol) address information of a data transmission destination, a first header or channel information dependent on said one physical network, and an information indicating a required communication resource;

(b) transmitting a second control message to said another physical network when the step (a) receives the first control message, the second control message containing a second header or channel information dependent on said another physical network which is obtained from the IP address information, and the information indicating the required communication resource;

(c) establishing a communication path with respect to a receiving node or a next network inter-connection node for connecting said another physical network and a third physical network, the communication path having the second header or channel information with the required communication resource;

(d) storing a correspondence between the first header or channel information and the second header or channel information; and (e) obtaining the second header or channel information corresponding to the first header or channel information according to the correspondence stored by the step (d) when the information data containing the first header or channel information is received from said one physical network, attaching the second header or channel information to the information data, and transmitting the information data to said another physical network.

20. The method of claim 19, wherein the first control message commands a registration of a correspondence between the first header or channel information and the second header or channel information, and

the second control message commands to the receiving node or the next network inter-connection node a registration of a correspondence between the second header or channel information and a header or channel information dependent on said third physical network.

21. A method of data transmission at a data transmitting node connected with a physical network comprising the steps of:

(a) transmitting a control message in a case of transmitting information data to a receiving node connected with the physical network or another physical network, the control message including an IP (Internet Protocol) address information of a data transmission destination, a header or channel information dependent on the physical network and an information on a format of the information data to be transmitted according to the header or channel information; and

(b) transmitting the information data in said format which contains the header or channel information, to the receiving node,

where in the control message commands to a network inter-connection node for connecting said physical

network and a next physical network a registration of a correspondence between the header or channel information dependent on said physical network and the header or channel information dependent on the next physical network.

22. A method of data transmission at a network inter-connection node for transmitting information data received from one physical network to another physical network, comprising the steps of:

(a) receiving a first control message from said one physical network, the first control message containing an address information of a data transmission destination, a first header or channel information dependent on said one physical network, and an information on a format of the information data to be transmitted according to the first header or channel information;

(b) transmitting a second control message to said another physical network when the step (a) receives the first control message, the second control message containing the address information, a second header or channel information dependent on said another physical network which is obtained from the address information, and the information on a format of the information data to be transmitted according to the second header or channel information;

(c) storing a correspondence between the first header or channel information and the second header or channel information;

(d) converting a transmission format of the information data to be transmitted from a transmission format in the said one physical network to a transmission format in said another physical network; and

(e) obtaining the second header or channel information corresponding to the first header or channel information according to the correspondence stored by the step (c) when the information data containing the first header or channel information is received from said one physical network, attaching the second header or channel information to the information data, and transmitting the information data to said another physical network.

23. The method of claim **22**, wherein the first control message commands a registration of a correspondence between the first header or channel information and the second header or channel information, and

the second control message commands to a receiving node or a network inter-connection node for connecting said another physical network and a third physical network a registration of a correspondence between the second header or channel information and a header or channel information dependent on said third physical network.

24. The method of claim **22**, wherein the information data to be transmitted by the step (d) is MPEG data, and the step (e) converts the transmission format of the MPEG data from a transmission format for the MPEG data in said one physical network to a transmission format for the MPEG data in said another physical network.

* * * * *

PATENT
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: **Lu et al.** Serial No.: 09/909,224 For: AUDIENCE MEASUREMENT SYSTEM FOR DIGITAL TELEVISION Filed: July 19, 2001 Group Art Unit: 2623 Examiner: Justin E. Shepard	I hereby certify that this document is being deposited electronically with the United States Patent and Trademark Office on this date: **December 3, 2007** /James A. Flight/ James A. Flight Registration No. 37,622 Attorney for Applicants

RULE 132 DECLARATION OF JOHN HOUSTON

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

I, John Houston, hereby declare and state:

1. I am the named inventor of U.S. Patent 6,353,929 ("my patent"). As such, I am very familiar with the content of my Patent.

2. Because of that familiarity, I have been asked to independently review U.S. Patent Application Serial No. 09/909,224 (the "'224 application"), the claims of the'224 application as presented herewith, the rejections made in the final Office action mailed on August 1, 2007, Ozkan, U.S. Patent 6,031,577, and the applicants' arguments filed June 28, 2007. I have reviewed these materials and am presenting this declaration to support the applicant's request for a continued examination, and to assist the USPTO in its examination of the '224 application.

3. I have reviewed the final Office action's argument that my patent is directed toward a tuning device. However, I respectfully submit that the Examiner misunderstands my disclosure when he describes it as a tuning device. My patent is directed toward an audience measurement system. It is not a tuning device and it does not seek to affect how audience members utilize their tuning devices nor does it seek to affect how such tuning devices operate to tune programs. Instead, specifically with respect to tuning devices, my patent relates to measuring how audience members utilize their own tuning devices. As such, there is no reason apparent to me to modify my patent to enable tuning of any sort, let alone to enable tuning "to sub-channels without acquiring the program map table (PMT)" as stated in the Office action.

4. The cooperative media handler methods disclosed in my patent provide access to a rich amount of audience measurement data, so there is nothing to be gained by employing eavesdropping methods such as those disclosed in the '224 application when my disclosed methods are available. Therefore, in my opinion, a person of ordinary skill in the art reading my patent in the relevant time frame would not be led by my disclosure to the invention recited in claims 62 and 80 of the '224 application as currently presented in the response to the Office action of August 1, 2007 filed herewith. Quite simply, the techniques I disclose and the techniques recited in claims 62 and 80 relate to fundamentally different approaches to media measurement. Since my patent has no need of eavesdropping techniques such as those recited in claims 62 and 80, in my opinion, no

person of ordinary skill in the art reading my patent would take it as suggesting the eavesdropping techniques of the '224 application.

5. With respect to independent claims 13, 61 and 79 of the '224 application as presented with the Response to the Office action o fAugust 1, 2007 filed herewith, my patent makes absolutely no mention of collection and/or timestamping PID headers as a useful vehicle for performing media monitoring. While it is true that the methods and apparatus disclosed in my patent could certainly collect such PID headers (the methods and apparatus I disclosed can be used to collect virtually any type of media measurement data), my patent does not specifically disclose the concept of collecting and/or timestamping such PID headers or in anyway indicate that collecting and/or timestamping such PID headers would be of interest. Therefore, in my opinion, the only way a person of ordinary skill in the art at the relevant time frame reading my patent would be led to collect and timestamp PID headers, is if that person had a priori knowledge of the value of collecting such PID headers from another source.

6. I agree with the position that my patent described collecting payload data which may be associated with PID headers and, thus, my patent does not by itself motivate someone to collect and timestamp PID headers.

7. I understand that willful and false statements and the like are punishable by a fine and/or imprisonment under 18 U.S.C. § 1001, and that any such willful and false statement may jeopardize the validity of this application and any patent resulting therefrom.

Date: 11-30-07 By: John Houston

John Houston